Editorial

ALTHOUGH there has been a fair amount of general discussion about television during the month, the only statement of a positive nature was that of Mr. Anthony, the PMG, who said that he did not propose at the moment to consider more than two stations in any one capital city.

This means that the ABC is almost certain to operate one of these two stations, with a likelihood of the other being a commercial station.

With the wisdom of Mr. Anthony's point of view there can be no serious quarrel. With his further statement, that he was more concerned with the problems of the set owner than with the profit and loss angle of station operators, one must also agree.

It is, of course, obvious that no commercial station can run at a loss. It is equally true that the large accounts which are available in the radio advertising field play probably the biggest part in the selection of programmes. When someone realised the large number of people who liked to listen to heartrending serials and quiz sessions, it was a red letter day for advertisers. But it just about wrecked listening pleasure for the thousands for whom neither form of entertainment holds any appeal.

As it is only natural that the quality of such sessions should become pitifully poor in the struggle to maintain output, we have a rather vicious circle which doesn't do the programme standard any good.

Most commercial station operators are aware of this position, but are forced to support it if they are to make out in the race for revenue. It is true that of late many commercial stations have attempted to introduce a better note into their programme material. But even this material is generally negatived by desperate devices designed to preserve the eternal "popular" appeal.

Television cannot afford to be manoeuvred into the same position. The horror of seeing as well as hearing about the irresistible features of salable articles will, I am sure, deal a blow to television from which it may not recover, unless great discretion is used. To load ourselves with so many television stations that there are not enough good programmes to go round will be a fatal step.

More than once I have mentioned the need to approach television programmes with the greatest skill and care. Nothing less will ensure that receiver owners will get value for their money.

John Moyle

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RADIO AND HOBBIES IN AUSTRALIA

A NATIONAL MAGAZINE OF RADIO, HOBBIES AND POPULAR SCIENCE

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OUR COVER PICTURE

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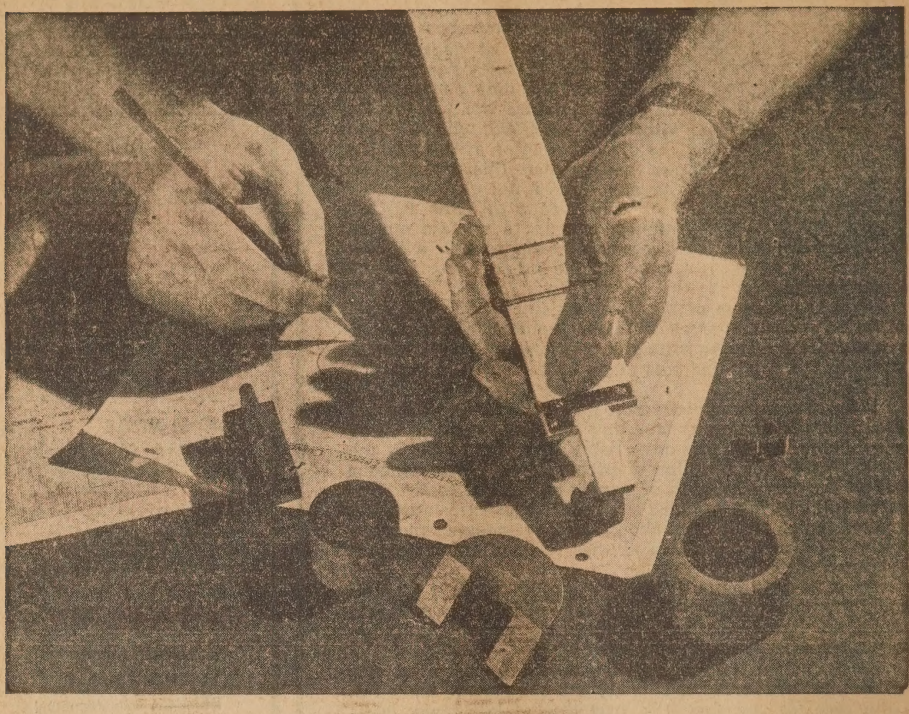

REMARKABLE NEW MAGNET ALLOY DEVELOPED FOR LOUDSPEAKERS

Seventeen years ago, the magnet of a six inch P.M. type loudspeaker weighed 3½lb. Today the same size speaker uses a magnet weighing only six ounces.

Not only is the modern P.M. loudspeaker smaller and lighter than its 1932 prototype but its efficiency is very much higher—in fact equal to that of the power-wasting electro-magnetic type it has superseded.

Chief credit for this improvement must go to the physicists who evolved the Alnico magnet alloys and brought them to their present pitch of efficiency. Among the world organisations engaged in magnet manufacture, Rola Company (Aust.) Pty. Ltd. has been in the forefront of this research and developed the famous Anisotropic Alnico used in its loudspeakers during the past four years.

Now Rola Company (Aust.) Pty. Ltd. researchers have evolved an even better magnet alloy, one which permits a further 25% reduction in loudspeaker magnet weight without impairing the high efficiency of its famous loudspeakers.

You'll be seeing some of these new loudspeakers soon. Though you won't be able to detect any difference in their performance compared with that of earlier models you'll know them by their shorter magnets, a visual example of the progressive thinking and engineering skill which has made Rola "The World's Finest Loudspeaker."

ROLA COMPANY (AUST.) PTY. LTD. The Boulevard, Richmond, Victoria, and at 116 Clarence Street, Sydney.

LATEST PHOTOGRAPHY FROM AIR

Easy maintenance of cameras inside hinged nose of 600 mile-an-hour Lockheed RF-80 jet photo reconnaissance plane is shown in this picture. A modification of the US Air Force's famed F-80 Shooting Star fighter, RF-80 photo-recon units have mapped thousands of square miles of inaccessible areas at jet plane speed. Fairchild trimetrogon mapping cameras, shown in this version, shoot directly down and to each side simultaneously covering wide areas from horizon to horizon. As much as 20,000 square miles may be photographed on one three hour flight. See story on page 7.

MACHINES GUIDED BY ROBOT BRAINS

Dr. and Mrs. W. Grey Walter have designed two electric "tortoises" to assist in research work on the nervous system. The one called "Elmer" is in the centre and the other, known as "Elsie" is on the right. On the left is the hutch which contains the recharger.

This remarkable account of two machines which actually behave as living creatures controlled by an elementary nervous system illustrates how practicable may be the robot of the future operated on a more elaborate scale. There seems little doubt that somewhere in the future a "robot age" awaits us.

By DR. W. GREY WALTER, of the Research Department, Burden Neurological Institute, Bristol, England.

STUDY of the brain has benefited in two ways from the recent advances in electronics. First there is the application of principles developed for radar and television to the problem of recording the electrical changes which accompany brain activity in health or disease—the science known as electro-encephalography. Second, there is the construction of working models to test the various theories of brain function.

Some of these models are very simple and resemble the brain in only one or two respects—they are chiefly of academic interest. Others are more elaborate and are intended to bring together several of the better known properties of the nervous system to see whether any of the other more mysterious ones emerge as the result of the combined activity of elementary processes. As a consequence of these experiments a race of electro-mechanical robots or synthetic animals has been created.

the first pair, called machina speculatrix, was designed by my wife and myself. Our work at the Burden Neurological Institute at Bristol, Somerset, England, on brain function gave us the ideas which we have built into our "tortoises" "Elmer" (electro mechanical robot) and his consort "Elsie," who now shares our home.

These creatures are about 18 inches long and move around on three wheels. They are powered by miniature electric motors and ca their own batteries under their she As in animals—and humans—m of their weight is skeleton-chass muscle-motors and stomach-b teries, but their essential organ the miniature brain containing or two radio tubes, two electrical rela two condensers; connected to photo-electric cell or eye and a se sitive contact contained in the she this brain gives the model anim the power to roam all over the W ter house avoiding tables and chai searching for lights by night a shady corners by day.

Having observed their behavior over a year, their "parents" st cannot tell exactly how they w act in any particular situation, thou their general habits are fixed by t way they are made. Unlike oth machines, they do not wait to given a task but look around i dustriously for lights, which

m mean the power they need to
rge their batteries. But they
hard to please—sunlight, even
light of an English winter is too
ght for them.

hey prefer the small lamp in
r hutch where they can find the
come contacts from which flows
nourishing direct current they
ve. However, when their bat-
es are well charged, even the
ter and glowing energy of their
ch repels them and in the even-
they emerge to roam, visiting in
all the lights and bright sur-
s in the house.

ften they bump into some
sehold obstacle, when they
wl, butt back and come again
patient dexterity, sidling and
ging until they are clear once
e. While they are in this sort
rouble they care nothing about
t, only about the problem in
d, and for a second or so after
are free their short memory re-
ns an impression of the incident,
they can' get well away before
ting after some other will-o'-
wisp.

this they are more sensible
a fly which bumps itself to
h against a window-pane and
heir moderation they excel the
h which cannot resist a candle.
heir speculative, exploratory
d, too, avoids the dilemma of the
verbial ass which starved to
h midway between two equal
s of hay. When equidistant from
equal lights, "Elmer" or "Elsie"
first one and then the other,
solving a problem which wor-
the scholastic philosophers by
loying a searching mechanism
logous to that in our own brains.

Y NEVER MEET

ach model is fitted with a flash-
t bulb which is alight only in
kness—when they see another
t their own is turned off.

his has two odd effects; when
see their own light in a mirror
start toward it, as to any
r light. But the moment they
o it is turned off, so they turn
y—but instantly it reappears.
the light flickers in a signal of
recognition. Odder still, when
models are near one another,
is attracted to the other's light,
in the act of responding to the
r's charm, the source of attrac-
is extinguished; so, though
wn together, they can never
t. Quite literally, disillusion
ows on the heels of impulse.

ne can play quite exciting games
these creatures. They can be
le to run races out and home
n, and as they get closer to
r goal they begin to interfere
one another, banging and
ing like footballers in the goal-
ith, or two players armed with
nlamps can try to inveigle the
r tortoise into their reach, each
ng to get the other into a diffi-
position as well as to attract
own fancy.

Elmer" and "Elsie" are fascin-
g toys—though masterful young
dren may find them too inde-
dent to make satisfactory play-
gs—but what lessons do they

FRIEND OR FRANKENSTEIN?

Elektro—the 7ft giant which smokes, talks, and counts.

Mullard

PIONEERS IN ELECTRONICS

The science and practice of electronics doubtless commenced with the first application of the thermionic electron tube—familiarly known as the "valve". The name of Mullard was closely associated with the early developments of the valve and Mullard was one of the first in the world to manufacture valves commercially. During the first World War Mullard Valves were used extensively by the Services, particularly the Mullard Silica Transmitting valves supplied to the Admiralty. Then, as now, Mullard Silica Valves were famous for their long life and high efficiency.

Early radio experimenters remember affectionately their first valve — carefully nursed and wrapped in cotton-wool—which in a majority of cases was the famous Mullard "ORA". Those letters represented "Oscillates, Rectifies, Amplifies"—one valve type for all purposes. Today, the Mullard range of valves includes a highly-developed specialised type for every conceivable application in science, industry, defence and entertainment.

In the television field, too, Mullard was (and remains) right out in front. The late John L. Baird is recognised as the "father" of practical television and most of the special tubes and valves he required were developed and made by Mullard. From that beginning Mullard has become England's leading source of electronic tubes for television and special defence applications.

There is hardly a field of application for electronics with which the name of Mullard is not intimately associated. In all modesty, Mullard can truly claim the title "Pioneers in Electronics."

In the field of electronics—"Communicate with Mullard"

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Electronic Tubes:

Radio Receiving Valves.
Radio Transmitting Valves.
Industrial Valves for Heating and Control.
Hearing Aid Valves.
Special Television Valves.
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MULLARD-AUSTRALIA Pty. Ltd.

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Mullard

teach? First, they contain only two active elements as compared with the 10,000-million of the human brain, yet by connecting these humble units in a suitable electric circuit, they have been endowed with something very like free-will and their behavior is not as different from ours as a factor of 5000-million would suggest. This may mean that the vast number of single cells in the brain is not a true index of its complexity—the cells may work in great clumps of a million or so at a time and the problem of finally understanding how the brain works may be less hopeless than was feared.

CERTAIN CHARACTERS

Another important lesson is that to make the creatures work satisfactorily with so few units we had to incorporate several ideas which we had glimpsed first in the brain of four experimenal subjects as electrical effects of unknown significance. In one case, at least, after the models had been made we found they had certain characters which we had not planned for—and these also resemble very closely mechanisms which have been known for some time in the brain, but not understood. Now perhaps their function in real animals can be worked out from the clues supplied by machina speculatrix.

One aspect of these experiments I would stress particularly—the attempt to copy authentic life may help toward familiarity with some of its mysteries, but it does not breed contempt. Far from it; experience with machina speculatrix has intensified and concentrated the respect and admiration for living things which is part of a biologist's philosophy.

Amplifying the story of the robot wins, we can observe present progress in robot design with the following account of activity in various parts of the world.

When Harvard University recently unveiled a new 10-ton electronic calculator, which uses its own "language" and "memory" to solve complex mathematical problems thousands of times faster than man, the invasion of our times by the robot machine reached new heights.

Dozens of robot devices have been revealed in the past few months. In London, scientists developed a robot brain that signals its own moves in a game of chess, can memorise a bookful of facts and figures, may eventually be able to cook if its inventor can give it a sense of smell.

A robot machine in Scotland never loses a ticktacktoe game. When its human opponent plugs in one of nine electrical contacts on a board, an "X" appears in the corresponding space on a glass screen. A few seconds later the robot's electronically selected "O" lights up. You may get a draw, but you'll never win. Another robot not only regularly beats all-comers at an ancient Chinese game called Nim, but keeps its own won-and-lost record.

These examples of electronic magic are not isolated ones. Experts say the era of robots is upon us. From simple household tasks to astronomical computations, automatic devices possessing almost-human powers are taking over with such fantastic magic that in a less enlightened age their inventors might be burned as sorcerers.

ALREADY IN USE

Robots are already a part of our daily lives. Automatic dish-washers, kitchen ranges that turn themselves on and off, self-defrosting refrigerators, coin machines that make change, garage doors that open when a headlight beam strikes them or when a car horn sounds—all these are robot-like devices.

Nor is the idea of robots strictly a dream of today's experimenters. Philosopher-scientists of the Middle Ages designed mechanical men that walked, opened doors, played musical instruments.

Later there was a robot that even "talked"; it had bellows for lungs, a bagpipe's reed for vocal cords, a box for a mouth, and an india-rubber funnel, moved by keys, that acted as word-forming lips and tongue.

But today's mechanical men are more talented. Westinghouse's Elektro, a seven-foot, 260lb automaton, can smoke, count to 10, and deliver a speech with a vocabulary of 77 words. The brain of this aluminium-and-steel humanoid (human-like mechanism) is activated by 82 electrical relays which—in response to spoken commands—operate a "nervous system" of motors, levers, gears and chains.

Hundreds of miles of wire run up and down Elektro's spinal column. He even has a robot dog, Sparko, whose two motors enable him to beg, bark and wag his tail.

"WILLIE" PLAYS A HARMONICA

A Hammond, Ind., inventor Andrew Bober, gave electronic birth to "Willie," a dapper metal man who performs all the basic human motions, also sings, dances, plays a harmonica and fires a pistol.

Most modern robots are unseen electronic relays that can do almost everything from identifying unknown substances by their chemical "finger-prints" to chain-smoking cigarettes in a test for toxic gases.

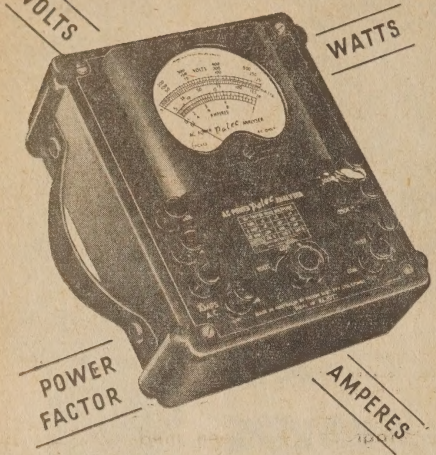
Three machines in Britain comprise the world's only robot librarian. Working with a new kind of punched

(Continued on Page 89)

AIRCRAFT HAS DECK STAIRWAY

Portion of the upper deck of the US Navy's Lockheed Constitution. The top of the stairway to the lower deck adjoins the pillar in centre. The Constitution featured on our cover picture, can carry up to 180 men.

2 NEW PALEC STARS



PALEC MODEL PA POWER ANALYSER

1

The Palec A.C. Power Analyser, Model PA, Australia's first dynamometer multi-meter, for electrical service, maintenance and testing.

RANGES:

VOLTS A.C.-D.C.	AMPERES A.C.	WATTS A.C.
0—125	0—1	0—10,000
0—250	0—5	9 ranges of watts
0—500	0—20	3 for each voltage range

POWER FACTOR: $\frac{\text{WATTS}}{\text{VOLT. AMPERES}}$: Rotary switch selection without disconnecting circuit.

POWER CONSUMPTION: Negligible.

ACCURACY: Effects of wave form, power factor, voltage, current and frequency variations are negligible.

The Palec A.C. Power Analyser incorporates a true dynamometer movement of the nickel-iron cored type. There are no rectifiers or non-linear resistances included, nor is it necessary to compensate for line voltage in wattmeter readings.

APPLICATIONS: Industrial maintenance, production testing, laboratory work. Particularly suitable for testing and servicing refrigerators and other motorised appliances. D.C. as well as A.C. voltage may be measured.

EXTRAS: Leatherette-covered carrying case, external resistance box for 3-phase testing and current and potential transformers for extending ranges supplied at extra charge.

DIMENSIONS: The Palec Power Analyser is housed in an exclusive semi-hard rubber case, size 8 inches by 9¼ inches by 4½ inches overall. Weight, 8 lbs.

Price: £23/15/- plus tax.

2

PALEC M.30 MULTIMETER

Model M.30—new 30-range multi-meter (superseding the famous model MCA)—is indispensable for modern radio and electrical technique.

Ranges—

D.C. Volts 0—0.1—3—10—30—100—300—1,000.

A.C. Volts 0—3—10—30—100—300—1,000.

D.C. Milliamps 0—0.3—1—3—10—30—100—300—1,000.

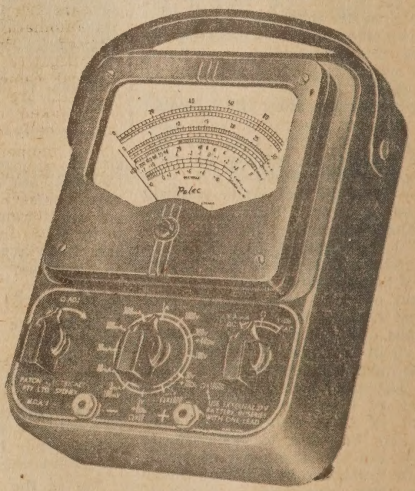
Ohms 0—10,000 and 0—1 megohm with internal Batt.
0—10 megohms with external Batt.

Decibels (a) Zero reference level = 6 milliwatts in 600 ohms: —17 to +3: +3 to +23: +23 to +43.
(b) Zero reference level = 1 milliwatt in 600 ohms: —10 to +10: +10 to +30: +30 to +50.

Other features: Meter scale, 4"; all measurements from two terminals only; bakelite housing; test leads supplied. *Accuracy, reliability, low cost.*

£11/17/6, plus tax.

M.30 MULTIMETER



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NEW PICTURE SPEED AND STABILITY

Sleek and clean—latest photo reconnaissance version of the USAF's famed Lockheed Shooting Star jet fighter resembles its fighter twin in every detail except the nose section. Designated the Lockheed RF-80, this photo-recon version substitutes varied arrangements of aerial and mapping cameras for the six machine guns normally carried in the RF-80 nose.

A new degree of speed and stability for aerial photography has been made possible by the latest photo-reconnaissance version of the Lockheed Shooting Star, standard jet fighter of the US Air Force. The main gain has been in the elimination of vibration caused by the propellers and piston engines, a fault which often caused blurring in aerial photos.

ANOTHER photographic disability, one suffered in flying at high altitudes, is obviated by the use of special filters and infra red film; jointly they enable haze to be penetrated and clear pictures produced of terrain that is obscured to the pilot. The speed advantage of this photographic machine is best indicated by the fact that flying at over 550 mph and at an altitude of 35,000 feet, the RF-80 has photographically covered 20,000 square miles on a single flight of three hours duration.

To cover so wide an area the plane has a big battery of special cameras which simultaneously photograph directly ahead, directly below and obliquely on both sides.

In the fighter version of the Shooting Star the nose of the aircraft is normally occupied by six machine guns. The photographic Shooting Star can accommodate, in this place, various combinations of five Fairchild aerial cameras. An ingeniously hinged nose-section permits easy access to this equipment. (See Page 3.)

Originally designed for wartime operation, the RF-80 has been used by US Air Force units for many civil assignments in the US. The work has included mapping and air-survey projects for the development of timber reserves, locating sites for hydro-electric projects and the routing of new highways and railway lines. An unusual job was to provide information for a wildfowl census being taken in a game refuge in California.

To correct the distortion which appears in photos taken obliquely, an automatic corrector has been devised. Prints are made when the negatives are exposed in split vertical cameras and the resultant pictures are as though they had been taken by horizontal cameras in the belly of the plane.

The temperature in the insulated and thermostatically controlled camera compartment is regulated to avoid even slightest shrinkage or expansion of lense or film, allowing for ground heats of 115 degrees and, at high altitudes, sub zero temperatures of down to 50 degrees.

Camera instruments are easily connected for automatic control by the pilot. Conditions, from normal to emergency, are indicated by electric signals.

Normal photographic equipment of the RF-80 is five cameras, each of which holds 390 feet of film. The negative areas in the camera are unusually large—up to nine inches by 18 inches. Co-ordination between frequency of pictures taken and the altitude of the plane is maintained by an intervalometer.

The efficiency of these jet photo-reconnaissance aircraft is indicated by the fact that the Lockheed Aircraft Corporation has already delivered more than 150 RF-80's to the US Air Force.

GERMANIUM TRANSMITS HEAT

LENSES that will transmit invisible heat radiation, promising spectacularly improved infrared equipment for scientific and industrial use, can be made from pure germanium and silicon metals.

Even though the metals are opaque to ordinary light and may be an inch thick, they transmit the infra-red rays over a broad portion of their spectrum. Heretofore, rock salt and other materials attacked by moisture and softer than metals have been used for optical work with infra-red radiation.

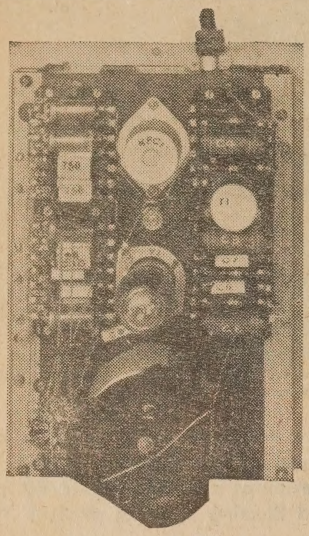
Pure germanium and silicon metals have been prepared which transmit 50 per cent of infrared "light" beyond two microns in wavelength. The loss that occurs is primarily due to reflection and not to absorption.

Filters as well as lenses will be made with these stable materials. Grinding the metals to the very accurate dimensions required for optical work will be very much easier with these metals than with the older, softer materials now used.

The researches are the outcome of electrical measurements on germanium alloys which were carried out during the war. It was these measurements that proved it was possible to make the metals semi-conducting either positively or negatively. Semi-conductors with known and predictable properties were available then for the first time.

(Science News Letter, December 10, 1949.)

ARMY
DISPOSALS EQUIPMENT



Internal View

A FEW USED BUT IN EXCELLENT CONDITION

Less Vibrator Supply

£7/7/-

Range, 1470kc. to 10,260kc. In three bands as follows 1470 to 2870, 2800 to 5520 and 5280 to 10,260. Wave meter operates on:—6 volts A.C. or D.C. L.T. for filament of valve and 90 volts H.T. (no batteries supplied). Valve used 1-6J8.

Jack provided for use with head-phones when used for checking transmitter.

Circuit diagram, parts list, working instructions, etc. Supplied with each wavemeter.

Weight 23lb. Size 15¼" x 10¼" x 8¼"

WAVEMETERS

(Class C)

(Manufactured by A.W.A. For The Army)

These wavemeters are ideal for the amateur station. Regulations demand that every experimental station has, as a part of its equipment, a calibrated wave-meter.

Now is your chance to complete that station with a necessary instrument at a fraction of its original cost.

100 ONLY

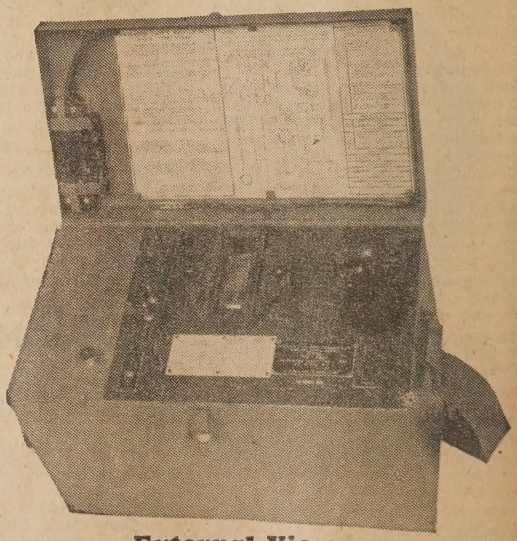
BRAND NEW

Complete with 6V Vibrator Supply

£10/10/-

Less Vibrator Supply

£8/10/-



External View

PHONE LA1604

EXCELAIR RADIO

136 VICTORIA RD., MARRICKVILLE, N.S.W.

PHONE LA1604

THE HISTORY OF ELECTRICITY—10

AMPERE—WHO NAMED ELECTRIC CURRENT

It was James Clerk Maxwell, himself a towering electrical genius of last century, who first described Ampere as "the Newton of Electricity," an appellation which is certainly as apt as it is a complimentary one

FOR just as Newton's investigations and calculations served to lay the foundations of physics and mechanics, so also did the researches of the ingenious Ampere, by their elucidation of the laws governing the action of electric currents, bring into being the practical science of electro - dynamics which deals with electricity acting as a motive force, a science which, indeed, culminated in the invention of the dynamo and the electric motor, and thereby introduced our present-day electrical age.

Yet, curiously enough, electricity was only a sideline with Ampere. His interest covered almost the whole gamut of the sciences. He was a botanist, a mathematician, a physicist, a devoted student of natural history, a chemist, an astronomer, a classical linguist, to mention only a few of the subjects in which Ampere made himself prominent.

Nevertheless, if Ampere had not turned his attention to electricity we should never have heard of him in the ordinary way of things. The "amp.," that conveniently abbreviated designation of the unit of electrical quantity, which is Ampere's most lasting memorial, would never have come into existence.

Andre Marie Ampere lived a crowded life. Invariably he had half a dozen irons in the fire at any one time, so that it is impossible for us to trace out his career in any detail.

He was born in Lyons, in the south of France, on January 22, 1775, the only son of one Jean Jacques Ampere, a well-known merchant of that town. Jean Jacques had been in a prosperous way of business, and soon after his son's birth he retired from active trade and settled down as a country gentleman in a village not far away.

AN INFANT MATHEMATICIAN

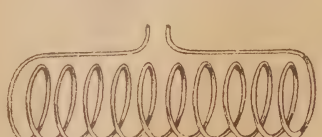
Andre Marie, the future electrician, turned out to be an almost uncannily precocious youngster. His innate mathematical ability showed itself the earliest. When he was barely seven years of age he was doing long calculations with kidney beans or pebbles, and, having acquired the ability to read, his first choice of books took the form of treatises on algebra.

When he was twelve he was battling with Euler's and Bernouilli's mathematical works on the differential calculus, treatises which were written in Latin, which language he mastered especially for the purpose

Andre Marie Ampere.

of comprehending these two great masters.

There was no regular schooling for Ampere in those days. He seems to have learned what he liked, being aided in the process by his father and by the kindly Abbe Dubarron, the learned librarian of the College



A wire helix or solenoid which, under the influence of electric current, behaves like a magnet.

of Lyons. It was Ampere's wont in after life to remark that at the age of eighteen he knew about as much mathematics as there was to learn, whilst it is a fact that at about this age he had read through and apparently thoroughly digested the great French Encyclopaedia of Diderot and D'Alembert, a colossal compilation running into 20 folio volumes. This great treatise on universal knowledge Ampere devoured from the beginning to the end. Years afterwards, indeed, he gave proof of his knowledge of its contents by reciting the substance of articles chosen at random from it.

In the midst of his placid and, perhaps, somewhat pathological intellectualism a storm broke with elementary fury into Ampere's life. It was the world-shaking storm of the French Revolution. It was an upheaval which carried away his father, Jean Jacques Ampere, to the then almost continuously operating guillotine of the Revolutionary Government in Paris, for Ampere *pere* had, in his retirement, been a *juge de paix* — in other words, a magistrate—and, as such, a member of the much-hated "aristocrats."

The tragic fate of his kindly father brought a great sorrow into young Ampere's life. He endeavored to drown it by assiduous study. He went for long excursions and botanising expeditions, and it was on one of these excursions that he met his first wife, Julie Carron.

After their engagement Ampere became a private tutor in Lyons, and not very long after his marriage he obtained a lecturship in chemistry and physics in a French county school. After a year or two Ampere was able to return to Lyons, having obtained (in 1803) the professorship of mathematics and astronomy in the newly-founded Lyceum in that city.

Less than a year afterwards his wife died. He then gave up his professorship at Lyons and sought refuge from his sorrows in Paris, obtaining there a post of tutor in the Polytechnic School.

After a little while things improved for Ampere. He settled down to his studies again, devoting much time to mathematics and building up his scientific reputation by the publication of original papers. In 1806 he was appointed secretary of the French Bureau of Arts and Sciences. And in that year, also, he married again.

A couple of years went by, after which he became an "Inspector-General" to the University of Paris. In the following year (1809) Ampere was nominated to the Professorship of Analytical Calculus and Mechanics in the Polytechnic School at Paris.

THE TOP OF THE LADDER

Ampere had now climbed almost to the top of the academical ladder. He remained in Paris for almost the rest of his life. All his researches, electrical and otherwise, were carried out under the roof of the great Polytechnic in Paris, and in the famed French Institute in that city.

From these seats of original learning Ampere published a large variety

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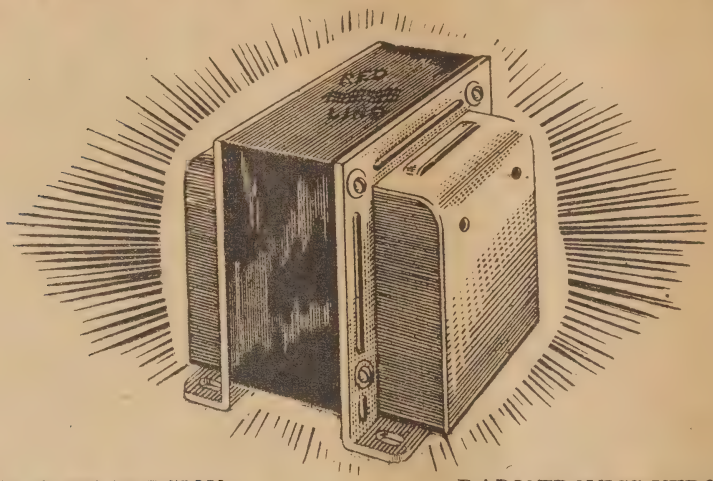

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of scientific papers on mathematics, physics, botany, natural history, chemistry and mechanics. The subject of electricity happened to be just one of the many studies which he "took up," as it were, almost automatically. It was a study which appealed particularly to the brain of Ampere on account of its need for mathematical treatment. Hence it was that his interest in electricity and magnetism, and afterwards in electro-magnetism, was mainly of a mathematical nature.

Let it be said at once that Andre Marie Ampere was no painstaking, practical genius in the electrical art as was, for example, our own renowned Michael Faraday. Indeed, Ampere failed to make any really first-class electrical discovery.

Yet it was he who, by systematising and explaining the discoveries of others, particularly the discovery of electro-magnetism which was made by Oersted in 1820, put electrical science on its feet and made it possible for future workers to have a clear understanding of the subject in which they were engaged.

The great Faraday, among many other original workers, was indebted to the more theoretically-minded Ampere for much of the groundwork on which he based his magnificent discoveries.

It was Oersted's discovery of electro-magnetism in 1820 which seems to have impelled Ampere in his Parisian laboratories to concentrate his attentions on electrical work. Within a week of Oersted's announcement of his discovery, Ampere had worked out an almost complete exposition of Oersted's electro-magnetic effect, and had demonstrated that all magnetic effects could be produced by the electric current alone.

Such a result of high-pressure work on the part of a single individual is almost incredible, but dates are dates, and anyone who cares to examine the publication dates of Oersted's and Ampere's original papers will be amply convinced of this fact.

AMPERE'S RULE

Ampere gave a definite rule for finding the direction in which a compass needle turns under the influence of an electric current, this effect constituting Oersted's original discovery of electro-magnetism.

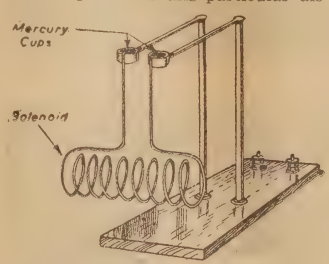
Said Ampere: "Picture a little mannikin swimming with the current while facing the compass needle. The north pole of the needle will then be turned to his left, while the south pole of the needle will be turned to his right."

This imaginary "bonhomme d'Ampere," as others quickly dubbed the electrical swimmer, has from Ampere's time been paraded in nearly all electrical textbooks as an aid to the student in determining the movement of the magnetic needle in relation to the direction of the electrical current, or, conversely, as a rule for ascertaining the direction of the current from the observation of the movement of the needle.

Ampere did more than this, however. He was the first to show that if electrical currents flow through two adjacent parallel wires, the wires will tend to attract each other when their respective currents flow in the same direction, but that the wires will tend to repel each other when their respective currents flow in opposite directions.

He showed that this force of attraction or repulsion is directly proportional to the intensity or strength of the currents and inversely proportional to the square of the distance between the wires.

Perhaps it was this particular discovery which James Clerk Maxwell had in mind when he first called Ampere the "Newton of Electricity," for, the reader will remember, it was the great Sir Isaac Newton who first announced a similar law with respect to the force of gravitation.



Ampere's method of suspending a freely moveable solenoid from mercury cups in order to demonstrate the solenoid's behavior as a magnet when a current is passed through it.

DISCOVERY OF THE SOLENOID

It was Ampere who introduced the electrical "solenoid" and, afterwards, the electro-magnet.

It is very interesting to trace the course by which these two discoveries came about, since, unlike not a few other discoveries, they were by no means creations of chance.

Ampere, in thinking out an explanation of the electro-magnetic effect observed by Oersted, postulated a theory which endeavored to account for the phenomenon of magnetism by supposing that the magnetic effect of, say, an ordinary bar magnet is due to a tiny electric current which continually circulates around each individual molecule or iron in the magnet.

In the non-magnetic state these supposed molucula currents circulate around the molecules in varying directions, but when the bar is magnetised the currents, according to Ampere's reasoning, must circulate in one direction only. So that, in effect, the sum of these minute circulatory currents would be equivalent to that of a larger single current moving in a series of circles.

Ampere's theory of magnetism was wrong, but it led to surprising consequences, practical as well as theoretical. It resulted in Ampere's trying out the effect of a single electric current flowing in a circulatory manner through a helix of wire. And, just as Ampere expected, under these conditions, the helix behaved when freely suspended or mounted, just as if it were a bar magnet, the hexis taking up a horizontal position north and south just as a bar magnet would do when freely mounted.

Ampere's electrical helix came to be known as a "solenoid," the word being derived from the Greek and meaning "tubular." Solenoids attract and repel each other, as Ampere discovered, according to their polarities just as ordinary magnets do. Indeed, as Ampere remarked, they are to be regarded as "skeleton magnets," or, as we might say today, synthetic or artificial magnets. And just as a bar magnet will communicate its magnetism, to a non-magnetic iron bar, so, too, will a solenoid impart its magnetism to a metal rod or bar which is placed within it, but out of any direct electrical contact with its coils.

THE ELECTRO MAGNET

Here, of course, we have the electro-magnet, the parent of countless electrical devices. Whether the first electro-magnet was made by Ampere or by his brilliant contemporary, Francois Arago, a French physicist and astonomer, seems to be doubtful. It was certainly Arago (not Ampere, as has sometimes been stated) who found that a conductor carrying a current would feebly attract and magnetise a needle of a nail placed across it, but it was Ampere who ascertained that the needle or nail might, under these conditions, sometimes become sufficiently magnetised to exert an influence on a suspended compass needle in just the same way as an ordinary magnet is able to attract or repel the pole of a compass needle.

It is fairly certain, however, that to Ampere goes the priority of reasoning that a coiled wire ought to intensify this effect, and of thus bringing into practical possibility not only the solenoid but also its direct outcome, the electro-magnet.

Based upon the idea of the electro-magnet, Ampere put forward the notion of an electric telegraph. But he was not practically minded enough to get anywhere with this project. For instance, the telegraph which he proposed was to be based upon the deflection of a magnetic needle by a wire coil carrying a current, but there were to be as many needles, coils and connecting wires as there are letters in the alphabet.

And since, also, the chemical battery was the only source of the electric current in those days, very great battery power would have been necessary for the operation of such a telegraph over any reasonable distance. Hence the whole notion of the telegraph as projected by Ampere was dropped in favor of more practical schemes which were not very long in forthcoming.

All the same, since Ampere's telegraph plan was announced in a

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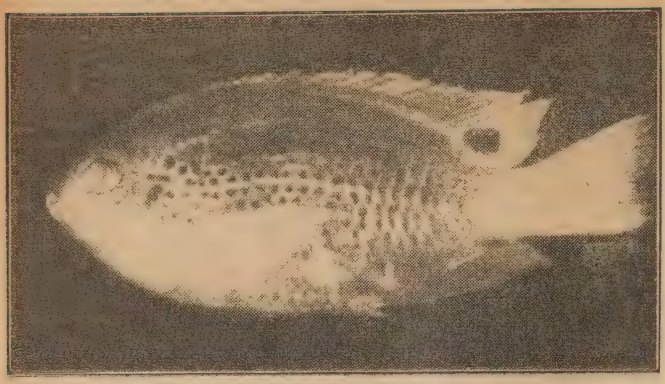

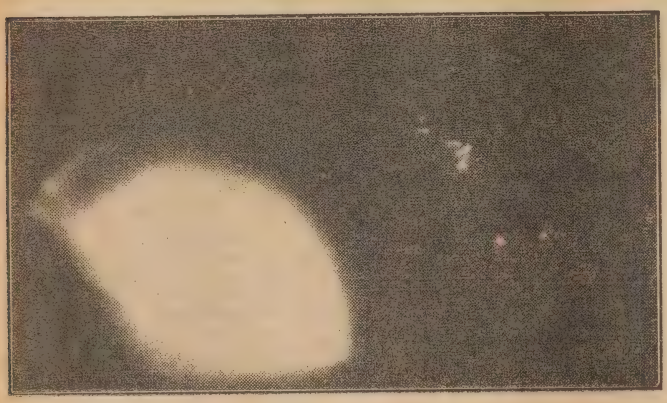

Auto photographs of fish captured from lagoon at Bikini Atoll. Note the radio activity in stomach caused by fish eating radio active matter from the water.

The methods devised for the handling of these materials are now well known. Huge concrete walls wherein all processes are carried out by remote control. Lead glass windows through which technicians watch the progress of the manufacture. Complicated devices to dispose of radio-active waste materials.

It is obvious that atomic energy for industrial purposes would be an expensive thing if such ways and means must be used in any plant making use of this energy. Simplified methods must therefore be found.

In order to give some idea of the problems involved, it is only necessary to consider the effects of radiation on the human body.

RADIATION TYPES

Five main kinds of radiation are met with in the course of the release of energy. These are as follows:—

ALPHA PARTICLES. Positively charged large particles. They cannot penetrate the skin, but can cause extreme damage if they gain entry into the body through broken skin or by internal deposition.

BETA PARTICLES. These will penetrate about one-third of an inch of human tissue. They are negatively charged and only moderately harmful.

GAMMA RAYS. A highly penetrative ray but less harmful than Alpha or Beta particles.

RADIATION—MODERN MENACE

If full use is to be made of the enormous potentialities of atomic energy means must be found of controlling the radiation which is set free and methods found for protecting the human body against its harmful effects.

IT is now recognised that an atom-bomb, aside from its death-dealing blast, causes terrible damage to those who have been affected by the radiation which is released. The effects of this radiation may not be felt immediately, but may put in an appearance months or even years after.

Yet atomic energy cannot be released without this radiation. In fact, the radiation IS atomic energy.

It is therefore not surprising that vast sums of money and much human thought and energy are now being applied in an effort to find ways and means of preventing or overcoming the bad effects of these penetrating, unseen rays of atomic energy.

That radio-active substances like radium give off harmful rays has been known for many years. Means have been devised of controlling the rays commensurate with the use to which they have been put.

This use has been limited mainly to treatment of disease and therefore control has been simple.

NEED FOR CONTROL

It is only since the advent of the atom-bomb that the need for greater control has become such a vital matter. For the very manufacture of the materials used involves the handling of large quantities of extremely radio-active substances.

NEUTRONS. These travel at high speeds and are not charged. They are very penetrating, and exceedingly harmful. At high speeds they can penetrate some feet of tissue.

X-RAYS. These are very similar to Gamma rays, but far less penetrating.

In what way do these rays harm living tissue?

All living things consist of much the same materials. One of the most important of which is protein. These proteins consist of molecules which use atoms of various elements such as carbon, hydrogen, oxygen &c.

The element carbon consists of atoms each of which carries in its nucleus six units of positive elec-

tricity. Around this nucleus are six electrons, each negatively charged. The atom is therefore electrically balanced and quite neutral.

All atoms bear this characteristic. They are electrically balanced, and as the living tissues use these atoms, the protein molecules are also balanced. They are electrically neutral.

While tissues are building and growing, there is involved a complex process producing muscular energy, removal of wastes, building up and breaking down of tissue so that the molecules are breaking up and recombining in a multitude of ways.

No matter how often this breaking up and rebuilding takes place, it occurs in such a manner as to always maintain the electrical balance of the molecule. If that balance is destroyed the living tissue would die.

Harmful radiation does just that: It destroys the delicate electrical balance of the molecules, and as these are part of the living cell the cell dies too.

PRESENT PROBLEM

Nobody as yet knows why radiation does this. We only know HOW radiation kills the cells. We don't know the mechanism by which it does it.

It is this WHY that is the present problem. Once this is known science will be well on the way to control radiation and prevent its harmful effects.

A further adverse effect is brought about by what is termed IONISING RADIATION.

When radiation breaks down the electrical balance of the atoms and molecules, it also smashes them into fragments carrying positive or negative charges. These are known as positive or negative IONS. Thus this kind of radiaton is called IONISING RADIATION.

These positive and negative ions recombine in anything like a normal manner, with the result that the tissue is completely unbalanced and new compounds are formed which are foreign to the delicately balanced living system. These are highly poisonous and in turn poison adjacent tissue.

In additon to this, free ions collide with radio-active particles, and are propelled off at a high speed only to penetrate other tissue which is affected just as if penetrated by the ionising radiation itself.

VARIOUS WAYS

Radiation affects living tissues in a variety of ways. For instance, Gamma rays and Neutrons, if penetrating deeply into the body, can completely destroy the function of the bone marrow, thus preventing the production of red blood cells. They can also cause damage to the intestines or organs of reproduction.

It has been found that the cells of the bone marrow and other tissues which have a rapid growth are more prone to damage than the cells of the brain.

Cells consist of an outer membrane enclosing a substance called protoplasm. Floating in this is a dense mass, the nucleus. Protoplasm contains proteins, which are built of still smaller masses known as AMINO ACIDS. There are about 20 kinds of these acids, and several hundred units of these in one protein molecule. The combination of amino acids runs into millions, which again make a possible billions of different kinds of protein molecules.

The study of radiation and its effect on protein molecules is thus a herculean task.

In various laboratories in America this task is being carried on, and important results are being obtained.

In the University of Chicago an astounding idea is almost ready for trial. It has been thought that only part of a cell is affected by radiation, or that different parts of the cell is affected in different ways.

In order to test this theory a machine is being built which will focus a tiny beam of radiation on to any part of a cell desired.

When it is considered that a cell of the human body is about one two-thousand five-hundredth of an inch in diameter it is seen how small a beam must be to focus on only a part of this. It must be no larger than one twenty-five thousandths of an inch in diameter.

This beam will be focused on any part of the cell and the process watched under a microscope.

EFFECT ON GLANDS

At another university, scientists are investigating the effects of radiation on the glands of the body, which secrete important substances into the blood stream.

They have gone so far as to encase the adrenal glands—near the kidneys—of rats with a lead sheath and then subjecting the animal to radiation of the whole body. It was found that such protection gave the rat a longer lease of life than the unprotected rat. The prospect of

by Calvin Walters

having to encase our glands in lead sheaths is not very inviting.

The workers are now trying out the effects of radiation on the adrenal glands alone. This will be done by administering radio active substances internally, while protecting the surrounding tissue.

The effects of radiation on important body chemicals such as vitamin C glycogen, cholesterol, &c., is also being studied.

At Argonne National Laboratory, it has been found that the disease fighting white cells of the blood called phagocytes, is most seriously affected by radiation. This discovery caused medical men to inject penicillin into those unfortunate enough to suffer from radiation burns.

Even the common animal, bird, insect, or whatever it is, the bat is proving of use in the experiments. The wing of this er, er, affair is only about one-thousandth of an inch thick. It is thus ideal for direct observation under the microscope.

It has been found that after the bat was exposed to radiation, the circulation of the blood slowed down. Further investigaton led to the discovery that this was caused by fragments of the broken down cells clogging up the capilliary blood vessels in the wing.

Bleeding often occurs in cases of very bad cases of radiation burns. An important discovery was that a substance in the blood which prevents it clotting in the blood vessels increased in quantity after radiation and thus contributed to the bleeding. It was found that two chemicals called respectively toluidine blue and protomine checked the bleeding by neutralising the harmful substance.

FREEZING

Even the freezing of victims has been tried out. Frogs have been given fatal doses of rays and then been chilled off. They lived in this condition for months, but when brought back to room temperature poor froggie died just the same.

The idea was that froggie might build up some sort of resistance in his body during the period he was living on this borrowed time. It was found, however, that the freezing merely delayed all repair processes so that when he was put between the blankets again old man frog got back to what he was before, just a burnt-up individual waiting for death. Freezing of one particular part of the body appears to be of some benefit.

It has been found that mice which were injected with proteins from other animals had a better chance of surviving than uninjected mice. Also an amino acid called cysteine, if given about an hour before irradiation, helped the mouse to survive injury. Whether an enemy about to drop a few atom-bombs will be kind enough to give us warning so that we can take our cysteine is a bit doubtful.

BLOOD TESTS

Research is also being developed along the lines of finding a blood test which will diagnose the extent of radiation injury.

Acute radiation may not be in evidence for some time after exposure, so that if a test is devised to determine the extent of injury immediately it will help considerably in the treatment.

Investigation along these lines has led to the discovery that after exposure to radiation the chloride content of the blood rises greatly about three days after exposure and remains so for a week. The protein content declined and what appears to be a kind of fat appears in the blood and remains for weeks after.

These facts may lead to a blood test which will detect damage.

(Continued on Page 99)

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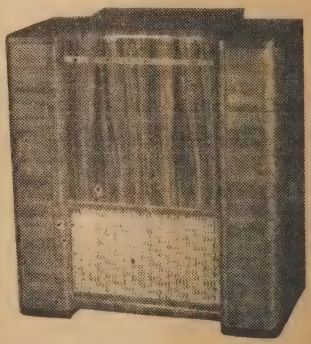

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Technical Review

NEW INSTRUMENT COUNTS NUCLEAR RADIATION

The well-known Geiger-Muller counter, used for detecting radioactivity, is being superseded on many applications, by a new type of instrument. Known as the "Scintillation" counter, it embodies recent developments from phototube research in the RCA laboratories.

THE scintillation counter consists essentially of an extraordinary phototube "eye" and a fluorescent screen or phosphor crystal.

When the instrument is exposed to radiation, radioactive particles strike the fluorescent screen and produce flashes of light. The light from each flash is picked up by the phototube and converted into a tremendously amplified electrical signal.

The signals are then further amplified and registered on a meter or other device to indicate the presence and strength of radioactivity in the immediate area.

Heart of the scintillation counter is a remarkable electron tube called the multiplier phototube. This photo-electric eye picks up the feeblest phosphorescent flash and converts it into an electrical current which is amplified as much as a million times before it is released to the other circuits of the instrument.

HIGH COUNTING RATE

The tube is capable of discriminating or "counting" radioactive particles arriving less than one 100-millionth of a second apart. This counting rate, considerably faster than that of the Geiger counter, greatly enhances the usefulness of the scintillation counter.

The tremendous amplification power of the multiplier phototube is accomplished by the phenomena of "secondary emission" within the tube. The tube contains a photo-cathode and a series of ten "dynodes" or amplifying stages.

The flash of light, caused by a radioactive particle, striking the fluorescent screen, falls upon the photo-cathode of the tube, releasing a number of electrons. These electrons are directed or focused electrically to the first of the amplifying stages, where each electron knocks off a new shower of electrons.

Each of these new electrons, in turn, is swept to the second dynode and again each knocks off a shower of electrons.

This process is repeated at successive dynode stages, until at the last stage a veritable avalanche of electrons is emitted, representing a multiplication of as much as one million times the number of initial electrons released by the original light flash entering the tube.

The electrons are collected at the last electrode to become the electrical output for the tube.

ENORMOUS AMPLIFICATION

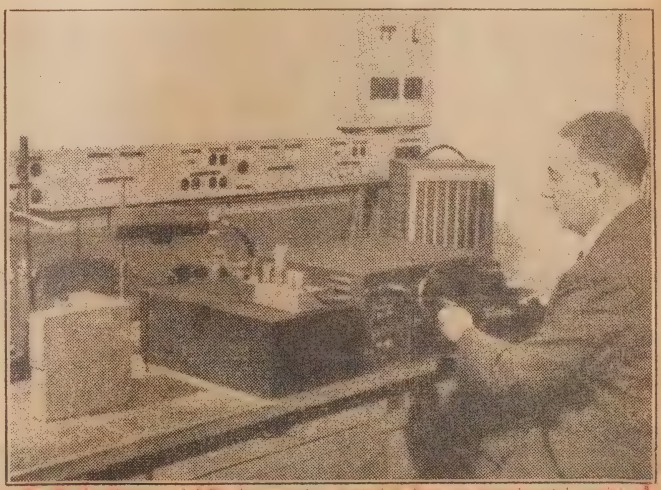
In addition to the increased counting rate and the enormous amplification provided by the scintillation counter, the new instrument has still other advantages over the Geiger counter. With suitable phosphors, this new detector is capable of detecting all atomic radiations known today, including "soft" radiations, such as alpha particles and soft beta-rays and X-rays.

The detection of these soft radiations with Geiger counters requires thin, hard-to-make "windows" to minimise the absorption of the soft radiations by the envelope of the detector tube. On the other hand, the scintillation counter built around the new phototube is rugged and stable, and has high intrinsic efficiency and indefinitely long life.

Although several multiplier phototubes have been previously introduced by RCA, the type designed specifically for scintillation counter work incorporates many new features.

For one thing, a new design, including a photocathode measuring 1½ inches in diameter, provides a sensitive area many times greater than that of previous tubes. This large cathode area permits very efficient collection of light from large-area light sources and allows the design of a scintillation counter which can "sweep" a broad area for traces of radioactivity.

GENERAL ELECTRIC research engineers announce that they have developed a new ionisation gauge which will allow accurate measurement of vacuums to as low as one trillionth of an atmosphere. During the war high speed pumps were developed which allowed vacuums of the order of one-millionth of an atmosphere to be obtained very quickly. New laboratory pumps, however, can produce vacuums that would have to be raised ten trillion times to raise them to normal atmospheric pressure.



Dr. G. A. Morton, of RCA Laboratories, seated before an experimental model of scintillation counter embodying a newly-developed RCA multiplier phototube.

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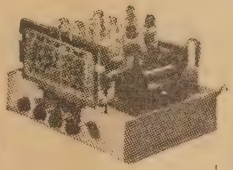

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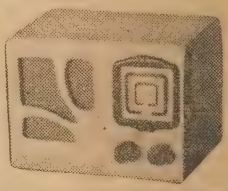

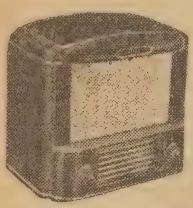

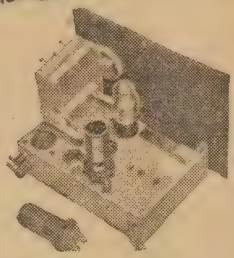

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In the famous Electronic Parts plastic cabinet and complete with valves, speaker, full building instructions, etc.

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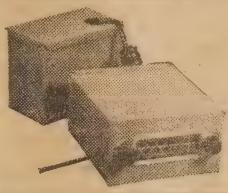
Specially designed kit set for radio students and beginners, this B/C and S/W battery kit gives maximum instruction in set building and coil winding. Complete with all parts including headphones, valves, batteries, full building instructions, etc.



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INTERCOM SYSTEM.
UNIT CRYSTAL SET.
SLUMBER SET.
METRO 4.
1947 ADVANCE CORNER SET, etc., etc.

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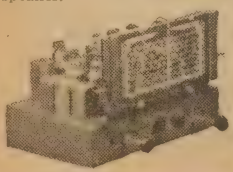
All kit enquiries and orders receive the personal attention of Mr. Don McEvoy, Radio Technician, who has a wide experience of kit construction. You can order your kit with full confidence from Electronic Parts Pty. Ltd.

1946 Standard

7 valve D/W A.C. console with R.F stage and push-pull output. Large straight line dial and 12" permag. speaker.



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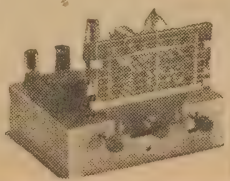
At last a 32 volt set for the countryman. Truly an amazing performance.



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KIT-SET SPECIALISTS

MIDGET BRITISH RECEIVERS USE EF50 VALVES

In Britain, as in Australia, wartime production has left a surplus of EF50 valves on the market. These are often available cheaply to experimenters. Recent issues of Wireless World have carried designs for simple regenerative sets using these valves in all sockets. It should not be difficult for Australian experimenters to adapt these designs for their own use.

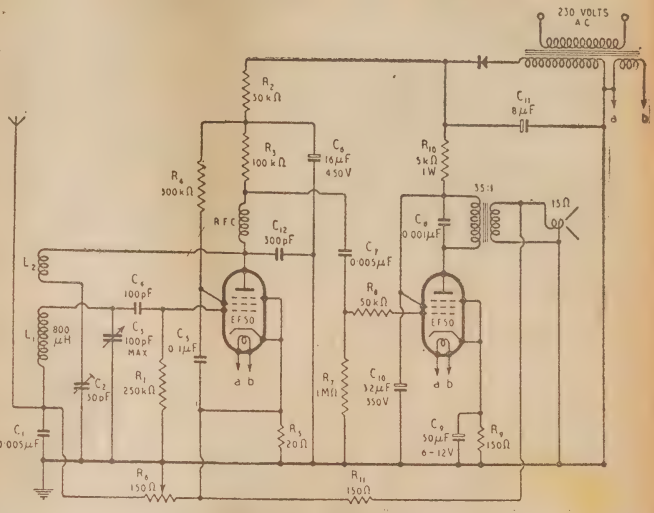
THE first circuit uses a simple regenerative detector followed by a pentode output stage. Power output from the EF50 is quoted as 0.5 watt for a signal input of 1.0 volt. This is ample for a small speaker, as would normally be used in a midget set.

The original receiver employed only a 100 pf tuning condenser, being intended for use in the London area. However, for full broadcast band coverage Australian constructors could substitute a regular 400 pf tuning condenser and a standard Reinartz tuning coil.

An unusual feature is the aerial coupling system, which is intended to give a low coupling factor with minimum dampling on the tuned circuit—this in the interests of selectivity. In areas of low signal strength the conventional coupling methods may give a better all-round result.

By the same token, a larger 100 pf reaction condenser may be desirable for a general coverage receiver. The 30 pf condenser in the original was intended as a present affair, and obviously a satisfactory arrangement where the choice of programmes is limited.

The EF50 output valve operates with 200 volts on the plate, draws 10 milliamps and requires a load of about 20,000 ohms. This is high for a midget transformer and, to offset the anticipated lack of inductance, the designer has provided a feedback network to the detector cathode. This network is also utilised to provide part of the volume control function, the feedback is varied by the action of the volume control, which also shunts the aerials in the "local" position.

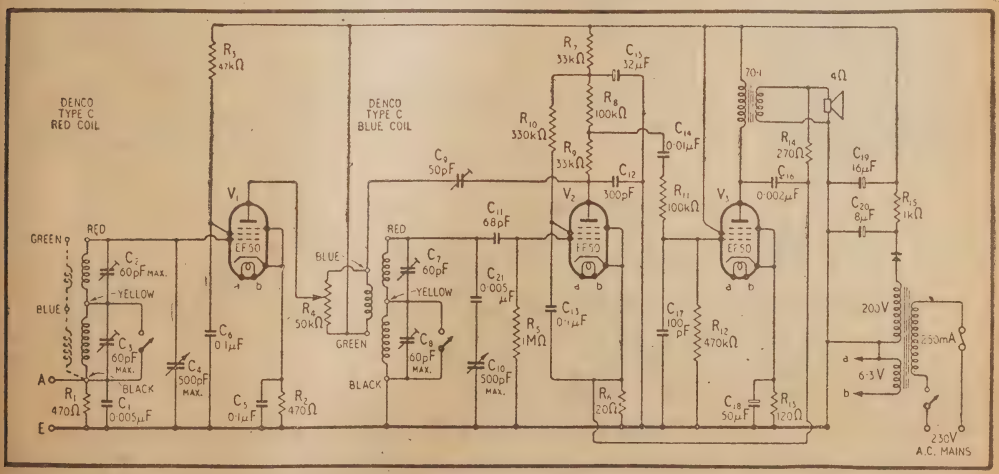


A "natural" for experimenters, this two-valve regenerative circuit boasts several novel features.

For the power supply a simple half-wave rectifier is used rated at 230 volts, 30 milliamps. Similar rectifiers can be obtained on order in this country, or a conventional 6X5-GT substituted and a standard small power transformer.

The second version of the set employs an RF stage, which obviously would add much to the gain and selectivity. Provision is made also to tune the long wave band but this could be deleted for local conditions.

Fixed negative feedback is employed in the audio end, and a single winding on the second coil serves both the RF amplifier plate and the reaction circuit. The RF gain control is novel but there is no reason why it should not be satisfactory.



Added gain and selectivity is provided by the use of an R.F. stage. Otherwise the circuit is similar to the smaller version. Note the novel R.F. gain control which prevents overload of the detector on strong signals.

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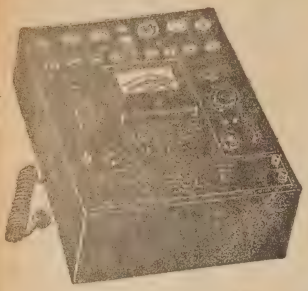

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MUTUAL CONDUCTANCE VALVE AND MULTITESTER

Fitted with large direct reading meter with illuminated dial and OVERLOAD PROTECTION. Tests over 2000 American English and Continental valves including latest types. Filament volts range from 1.1 volts to 117 volts. Filament continuity and element shorts shown directly on meter. Cathode leakage read in megohms. The instrument is housed in a solid oak carrying case and supplied with comprehensive instruction manual. Also available as valve tester minus multitester ranges—Model 45 A-S.

MULTITESTER RANGES. 1000 ohms per volt A.C.-D.C.

D.C. Volts	D.C. Current	A.C. Volts	Resistance
0-120 m.V.	0-0.6 mA	0-3	0.5-22.5-1000 ohms.
0-3	0-6 mA	0-15	50-2250-100,000 ohms.
0-15	0-30 mA	0-150	x 500-22,500-1 megohm.
0-150	0-150 mA	0-300	x 5000-225,000-10 Megohms.
0-300	0-1.5 Amps	0-600	
0-600			x with external battery.

PRICE £39/17/6 Plus sales tax.

IMMEDIATE DELIVERY

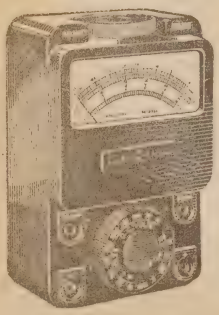
MODEL 75A

RANGES 20,000 ohms per volt A.C.—D.C.

D.C. Volts	A.C. Volts	A.C.-D.C. Current	Decibels	Resistance
0—0.1	0—1	0—50 uA	—30 to —5	1—50—10,000 ohms
0—2.5	0—2.5	0—5 mA	—22 to +3	1000—50,000—10 Megohms
0—10	0—10	0—50 mA	—10 to +15	*10,000—500,000—100 Megohms
0—50	0—50	0—500 mA	+4 to +29	
0—250	0—250	0—5 Amps	+18 to +43	*With external battery.
0—1000	0—1000		+30 to +55	

This is a robust 20,000 ohms per volt 50 range universal multimeter designed for accuracy and stability. Fitted into an attractive case, the meter is provided with instantaneous OVERLOAD PROTECTION. The clear, easy to read scale has a length of 4 inches. An internal buzzer is provided for quick continuity tests. Complete with test leads.

PRICE £19/15/- Plus sales tax.



MODEL 120A POCKET MULTIMETER

RANGES 1000 ohms per volt A.C.—D.C.

D.C. Volts	D.C. mA	A.C. Volts	Resistance
0—0.25	0—1	0—10	0.5—20—2000 ohms
0—10	0—10	0—50	50—2000—200,000 ohms
0—50	0—50	0—250	*500—20,000—2 Megohms
0—250	0—500	0—500	*5000—200,000—20 Megohms
0—500		0—1000	
0—1000		0—2500	*With external battery.
0—2500			

This is an accurate pocket size instrument using a robust, sensitive meter movement fitted with instantaneous OVERLOAD PROTECTION and is housed in a high grade moulded case. All resistors used for voltage and current ranges are adjusted to an accuracy of 1%. Supplied complete with test leads.

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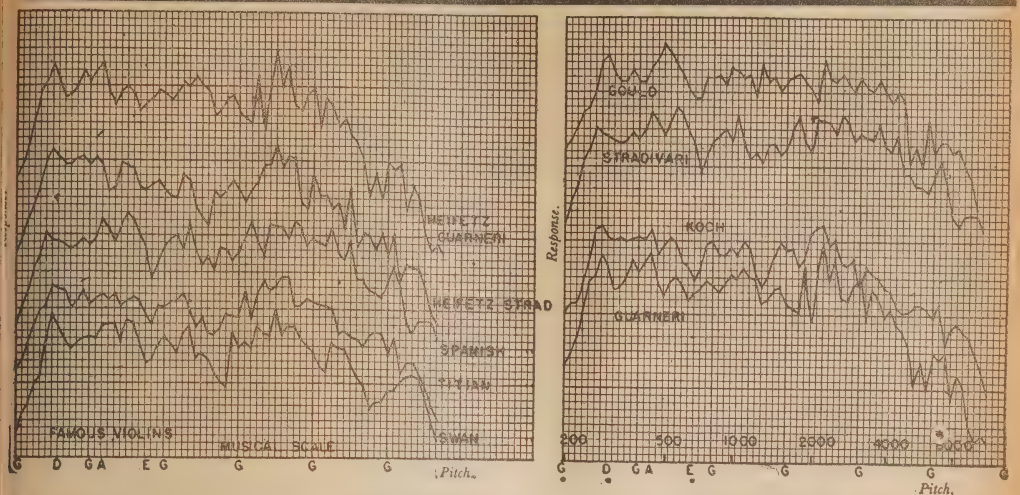
SCIENCE TAKES UP RIDDLE OF THE VIOLIN



Figs. 1-2—These curves show intensities of sound produced by violins when various notes are sounded by mechanical bowing. Fig. 1 (left) Five famous instruments. Fig. 2 (right) Old violins and modern copies compared; the lower of each pair of curves refers to an old violin, and the upper to a copy. (After diagrams in the Journal of the Franklin Institute, reproduced in the Physics of Music, by Alexander Wood, Methuen, 1944).

It is generally acknowledged that modern violins seldom, if ever, equal those by Stradivarius and others before the middle of the 18th century—but why? Did these early craftsmen possess an elusive formula or is the superiority merely the result of a long period of ageing? Science has not yet found a complete answer to these questions.

IT has been suggested seriously that a violin requires a maturing period, so that old violins are always better than new ones, in the same way that old whisky is better than the fresh product.

When a violin is played constantly for centuries, stresses arising from its vibrations may cause tiny cracks in the structure of the wood. Since the cracks will develop most in regions where the resistance to vibrations is greatest, constant playing may enhance its ability to respond to modes of vibration most needed by the player.

There is apparently some evidence that even modern violins improve with age, but only the passage of time can confirm this belief or otherwise. In the meantime, observations are confused greatly by the unreliable nature of listening tests.

Analysis in terms of frequency response under carefully controlled conditions reveals a similarity between famous makes and also between individual instruments and modern copies. Much investigation along this line has been carried out by an American worker, F. A. Saunders.

NOTE QUALITY

It is obvious from curves available that the loudness changes abruptly from one pitch to the next, and this must inevitably have an important bearing on the quality of any individual note.

Taking, for example, the top curve of Fig. 1, there is a peak at the second A and a depression near the third. Thus, if the second A is played, its second partial (the third A) will be weak. On the other hand, there is a depression at the second B and a peak near the third, so that if B is played its second partial will be strong. Thus these two notes will have quite different qualities.

The curves all refer to admittedly good instruments. When good and bad instruments are compared, certain obvious differences emerge. It is found, for instance, that in good violins, the natural resonances of the body tend to reinforce frequencies between 3200 and 5200 in a fairly even manner, whereas in poor instruments, these resonances are about 1000 cycles lower and much less evenly distributed.

STRUCTURAL ELEMENTS

Apart from pure electrical measurement, much can be learned from careful investigation of structural elements. Thinner wood, for example, decreases response curve peaks and lowers their amplitude The application of varnish tends to have the opposite effect, but there is little to support the contention that mysterious qualities can be attributed to the varnishes used by the old masters.

However, the observation of these and many other facts still does not provide a complete answer as to how to construct a good violin. Research (May, 1949) describes how one, N. Nicholas, set out to construct a good violin, not merely copying an old master, but seeking to reproduce the desired characteristics at each step.

The belly of an old master was always made of pine, with as little damping as possible. Nicholas contrived an apparatus for observing the damped vibrations from various woods, and likewise, chose pine for the belly. Maple, with a much less pronounced decay curve, was chosen for the back.

NATURAL RESONANCES

It was also found that the natural resonance of the belly and back had to be in tune with one another, the best tones apparently being D (287-304 c/s per second) and F (342-362 c/s). Since the size of both back and belly are fixed, tuning must be accomplished by controlling the thickness, and Nicholas evolved the novel method of establishing the thickness ratio of the respective woods by substituting test pieces for the D and F in a xylophone. The ratio of thickness turned out to be 1.46, so that it was only necessary, thereafter, to arrange for the thickness of the back to bear this ratio to that of the bell.

There were many other such carefully considered steps in the Nicholas violin, but of the resulting instrument, he reports: "It has a good sonorous tone, but is rather exacting to play."

This worker admits that the secret of a good violin still remains a secret, but is convinced that the problem merely awaits more co-operation among scientists who enjoy a concert played on first-class instruments, but who have not bothered to interest themselves in the problems faced by their makers.—(From Discovery, July, 1949.)

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MEASURING THE SPEED OF LIGHT

BOUT 1675, Ole Roemer, a Danish astronomer, computed bles to show the times of future lipses of Jupiter's satellites. aving calculated what should oc- ir, he observed the phenomenon om time to time. He noticed at while at one time the eclipsed noon" emerged at the right time, x months later in a similar lipse the moon appeared to be out 16 minutes behind time.

It was noticed that there appeared be a certain regularity about the crepancies, and it was found that nen the Earth was comparatively ar to Jupiter, the eclipse occurred time, whereas when the Earth is in a part of its orbit remote m Jupiter, the discrepancies were eat and the eclipses occurred late.

Roemer concluded that the differ- ce in the time was due to the fact at light took an appreciable per- il to travel from Jupiter to the rth.

The difference in the distance be- een the Earth and Jupiter at suc- ssive eclipses was appreciable, mounting to over 186,000,000 miles. emer assumed that the light from piter took about 16 minutes to vel across the Earth's orbit and worked out its speed as 186,420 les a second.

EASUREMENT

Since that time several methods of easuring the speed of light experi- entally have been devised, and it s been possible to measure its eed with great accuracy.

One of the methods now followed shown in this diagram-sketch.

A bright light is concentrated by a ns system and reflected by an in- ned mirror out through a toothed heel, and on to another lens set up veral miles away. The beam of ght is focused on to a concave mir- r, which reflects the beam back to e starting point.

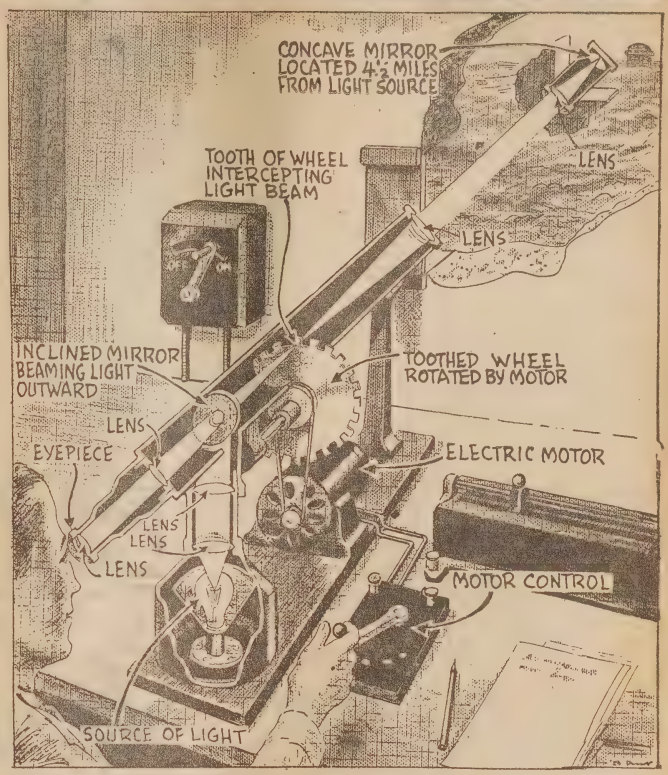
The scientist watches this reflec- on through a telescope which is t in line with the original beam.

When the toothed wheel rotates a certain speed the light reflection seen by the observer between the eth, but when the wheel's speed increased the light is intercepted the passing teeth.

As the time required for one tooth move through a certain distance n be calculated, it is possible to ork out the speed of the light in- rcepted.

For instance, if the wheel has 500 eth and is rotating at a speed of revolutions a second, then the me occupied by the light in travel- ng from the wheel to the distant irror and back is equal to the time eeded for a tooth to move into the sition of the gap in front of it.

The space the tooth moves in half he space between one tooth and he next—i.e., half of one-500th, and he time occupied is represented by



As light travels so rapidly, the time taken to traverse a few miles is too small to be noticed. But delicate scientific instruments can measure its speed. It was late in the 17th century when scientists first discovered that light took time to travel and did not cover great distances instantaneously. The discovery was first made as a result of astronomical observation.

1x1/500x1/20 or one-20,000th of a second. As the light travels a distance equal to twice the distance between the toothed wheel and the distant mirror, it is possible to calculate the speed of light. It is found to be 186,000 miles a second—the same as the speed of radio waves.

BLACK SCREEN FOR TV BACKGROUNDS

A BLACK screen for rear projection of television backgrounds, capable of providing greater pictorial contrast than the present conventional translucent white projection screen, is the latest innovation in video production to be introduced by the National Broadcasting Company.

The screen, which has already been used on several NBC television programmes, was designed and specially developed for video by the Trans-Lux Corporation and is known as a Tele Process screen.

According to O. B. Hanson, NBC vice-president and chief engineer, NBC, as the pioneer user of this type of screen, has made extensive tests which indicate that more "spill-light," a troublesome feature in the past, can strike the screen without loss of contrast or detail. "Spill-light" is the excess unwanted light that is reflected from a lighted stage or set onto a background projection screen. The new black, translucent screen absorbs this additional light without any noticeable loss of clarity.

"The new screen, used in conjunction with out latest rear-screen projection process, will enable production and programming departments to provide more realism in story presentation and better pictorial values to home viewers," Hanson said.

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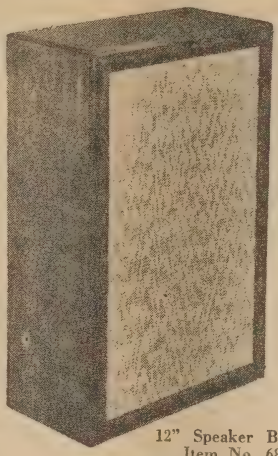

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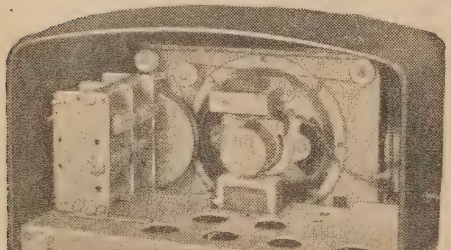

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NEWS AND VIEWS OF THE MONTH

RECORD SPEEDS

THE somewhat confused position over record speeds in America ems to be sorting itself out slowly nd the outcome is pretty much what e expected, except that the 45 m speed of the RCA Victor sys m has made a somewhat greater npact than at first seemed likely.

The first favorite seems now to be e 33 rmp system because it is the st for long playing. And as long laying is an absolute "must" for ie record of the future, irrespective most of any other feature, the 33 iscs seem more firmly established ow than those of any other speed. If the 33 speed has a disadvantage, owever, it is that it possibly is the ast satisfactory from the point of equency response, although this oes not mean that a wide range n't possible. But it is somewhat arder to get.

The 45 rpm speed, on the other and, is probably the best of them all this respect. It seems pretty cer in, however, that as the slow speed chnique is developed to the full, th systems will present no real dif culties about frequency range. hile fundamentally neither is bette an the 78 rpm, other things being qual, the new records have a much wer surface noise, and this allows better effective frequency range an with our present day shellac 3 rpm's.

Our reaction on first hearing the ng players—that the 78 rpm records ere now as dead as the dodo—ems to be the impression now in the tates. To quote from "Audio En gineering," "There should no longer be any excuse for remaining on the fence. The 78 is rapidly becoming obsolete, and record buyers might just as well recognise the 33 and 45 as the ultimate in recorded music."

While we hesitate to accept anything as the "ultimate in recorded music" we are prepared to subscribe to this viewpoint.

The gradual acceptance of both 45 and 33 rpm speeds seems confirmed by the production of gramophone motors to accommodate both, leaving the 78 out of the picture. This makes it probable that the best of the 78 recordings will be produced on either 33 or 45—the larger works no doubt on the 33, and single-siders on the 45. New major works will almost certainly be issued using one or other of the two new speeds.

Another disadvantage of persisting with 78 rpm is the need for a special reproducing head for them, with a 2.5 mil stylus. Both the 33 and the 45 use the 1 mil stylus, and this will undoubtedly become the standard from now on. If 78 rpm should persist, it is not impossible that the grooves might be reduced to this standard, but the more one looks at the position, the less attractive this old speed appears.

Not the least of the influences at work which affect this matter of record speed is that of broadcast stations, which are prolific users of records. Standardisation on the fewest possible speeds is most important here, particularly as nearly every station has available motors of an elaborate type for 33 rpm, which has of course been a standard for many years.

So far no announcement has been made by our local record manufacturers about speeds, but sooner or later, some action will be inevitable We cannot fairly accuse them of being lax in this respect, as so much hangs on decisions to be made that

RADIO CROSSWORD PUZZLE, No. 31

ACROSS

1. Volume controls.
7. Air traffic-handling station.
9. Circles.
10. Antenna feed system (abbr).
11. Trigonometrical ratio.
13. Implements.
14. Graphical diagram to compute formulae results.
16. Type of currents.
19. Capacity measurement.
20. Aperiodic.
23. Null test method (abbr.).
24. Hauled.
25. Dives.
26. Electric motor regulator.

DOWN

2. On all coils.
3. Electrolytic rectifier.
4. Unit of magnetic force.
5. Condition of two oscillator circuits with same frequency.
6. Oppositions to current flow.
7. Wet battery.
8. Kiln.
12. Interference guard bands (abbr.).
14. Without magnetic property.
15. Programme.
17. Damped alternating current (abbr.).
18. Light producer.
21. Types of crystal cuts.
22. Illuminate.

BELOW—LAST MONTH'S SOLUTION

M	E	T	E	R	S		H	E	A	T	E	R		
A			K		Y		O		R			U		
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R	E	E	D		T		N		S	C	A	N		
I		T		M	E	G		B		H		E		
X	R	A	Y		M		D	U	F	O	U	R		
				E			G							
C	O	U	P	L	E		B		H	A	L	F		
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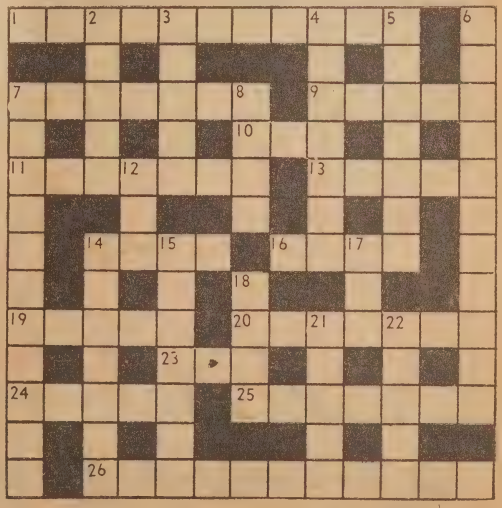

University news:

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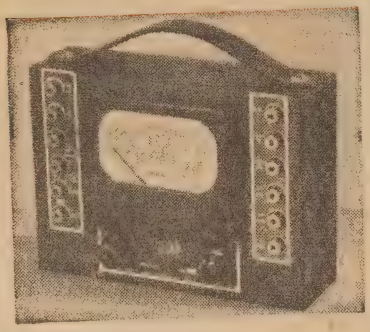


MODEL MK1 MULTIMETER KIT

This A.C./D.C. Multimeter Kit comes to you complete with everything right down to the last nut and bolt. It is carefully engineered and designed and all Resistors, Shunts, Meters, etc., are carefully pre-calibrated in the Factory to an accuracy of 1%. Thus when you complete building this Instrument there is no further calibration necessary.

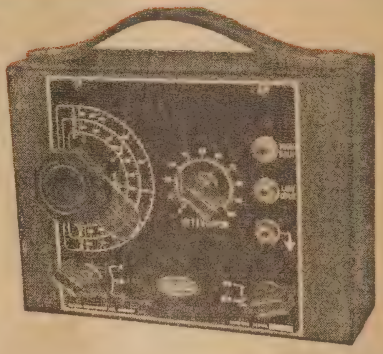
It has a wide range of A.C. and D.C. voltages up to 1000 volts and current can be measured in the following ranges:—

1, 10, 50 and 250 Milliamperes.

It is entirely self-contained for resistance readings, which are up to 100,000 ohms.

It uses the popular 4" Square Type Meter with a clear Multi-Scale. All wiring instructions and constructional details are given with the Kit and photographs and circuit diagrams make it simple. A completely illustrated well written Booklet of Instructions accompanies every Kit and your guarantee of satisfaction is in the name "University."

The size is 6" x 8" x 2½" and it's an exact physical replica in size to the Model OK1 Oscillator Kit, which is its companion. The price is £8/10/- plus 8 1/3% Sales Tax.



MODEL OK1 OSCILLATOR KIT

For years of active service yet simple to build at home with a few ordinary tools, Model OK1 Oscillator Kit covers all fundamental frequencies in the average receiver. It comes to you complete right down to the last nut and bolt and assembly can be done at home with a few simple tools. The Dial, Condenser, and Coil set-up is specially pre-calibrated at the Factory so that no further calibration is necessary when you complete building this Instrument.

Standard Batteries are used and each OK1 Kit is complete with an Instruction Book which gives pictures and wiring diagrams of all parts and in addition gives full operating instructions for using the Oscillator to the best advantage when you have finished it.

It is carefully packed and all Metal Parts are pre-calibrated so that no heavy work has to be done. Pleasing in appearance yet effective and simple in its use it makes an ideal Portable Battery Oscillator for the Serviceman or Home Builder. The price is the same as Model MK1 which is £8/10/- plus 8 1/3% Sales Tax. Other "University" equipment is available and you are invited to write for details.

16.FP9

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University

Made by UNIVERSITY GRAHAM INSTRUMENT CO., 5 NTH. YORK ST., SYDNEY. BU3169 (2 lines)

t is reasonable for them to wait until the position is as clear as possible before making any major changes. It is quite certain that there are no angles on the situation which have escaped the EMI group which virtually controls our record destinies, and we can only hope that not too much time will elapse before we are able to take advantage of the great improvements made possible by these latest techniques.

★ ★ ★

Space Ships

A. C. CLARKE, 32-year-old astronomer and assistant recretary of the British Interplanetary Society, recently lectured the Oxford University Heretics Club on space ships and life on other planets.

Said Clarke:

"First guided missile to reach the moon will probably crash into it in the fifties.

"First space ship capable of reaching another world may still lie half a century ahead.

"If theories about increasing heat of the sun's rays are correct and oceans begin to boil there is no doubt that stern necessity will bring about conquest of other planets.

"Application of atomic discoveries to space ships will cut the journey to a fraction of the time now estimated for chemical fuels.

"The journey to Mars would take 258 days by fuel propulsion, but an atomic ship would do it in a few weeks.

"Any races we encounter will almost certainly be superhuman or subhuman—most likely the former, since ours must surely be one of the youngest cultures in the universe."

★ ★ ★

Don't Forget Radio

A THOUGHT occurred to us the other day which was given point by odd remarks we have seen in overseas journals, particularly American. Briefly, it is that, when manufacturers begin to be taken up with the problems of television, they must not on any account allow their plans for straight broadcast receivers to fall into neglect.

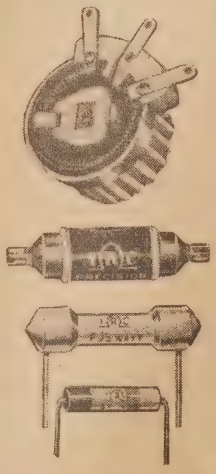
The possibility of this happening isn't so remote as might be thought. The design and manufacture of television equipment will be a full time job for most Australian factories, and when one's resources are strained by attention to such a new and complex field, something must suffer unless very careful planning is in operation.

Much has been said over the last few years about the revitalising effect television may have on the radio trade. Ideally, this will be true, but the backbone of this same radio trade must and will be broadcasting for many years to come. Unless a sane balance is rigidly maintained between the old and the new, the trade must be the sufferer in the long run.

When television does come, we must be in it, boots and all, if it is to succeed. But we cannot afford to allow such efforts to prejudice the bread and butter of the industry.

Perilously close—

but safe···thanks to Radar



The radar instrument warns the pilot (by a brilliant red light and a warning horn) the instant the aeroplane comes too close to the ground, any building, bridge, mountain, another aircraft or obstacle, regardless of darkness or weather conditions.

A war invention that contributed to air mastery, radar is now installed in passenger and freight planes throughout the world. It is the biggest contribution to air safety.

In radar, as in practically EVERY type of electrical equipment, IRC RESISTORS are standard components. For more than 25 years their proven superiority has made the IRC first preference wherever electric current is used—they are industry's first choice.

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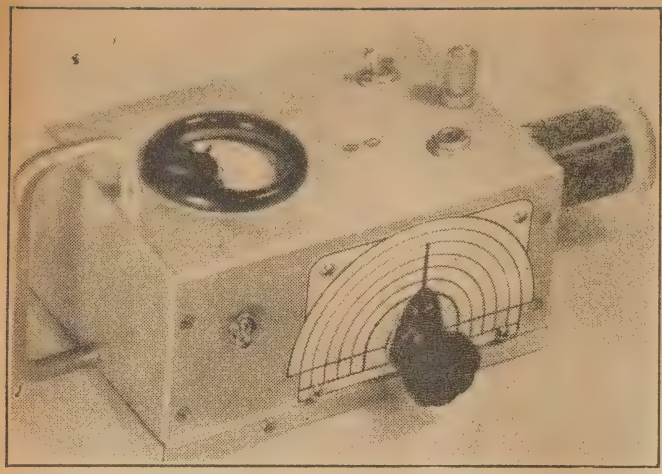


Here is the unit with the low frequency coil in place. The main on/off filament switch is on the right hand side with the tuning scale. The B battery switch for RF diode work is grouped with the plate circuit jack and aerial terminal on the top of the case. The grid circuit jack is not shown but it can be mounted in any convenient position.

cuit alignment a final "touch-up."

Fundamentally, the instrument i an oscillating frequency meter. Th spectrum of operation is covered b using plug-in coils, the tuning scal being calibrated for each range. Pro vision is made in the wiring of th coil so that the meter and batterie can be used with an external oscil latory circuit designed for the VH above 75 odd mc.

The principle of operation hinge around the fact that the gri current of an oscillator will de crease when an external tuned cir cuit is set to the frequency of, an coupled to, the tuned circuit of th oscillator. In practice, the frequenc of the oscillator is adjusted so tha the tuned circuit being investigated shows evidence of absorbing energy as indicated by a dip in the gri current read by the meter. Th frequency as shown on the scale o the grid-dip oscillator is then th resonant frequency of the circui under check.

Yes, it is as simple as that. A fe moments of careful thought will re veal strikingly the many usefu avenues and offshoots which ca emanate from this simple procedur

A GRID DIP OSCILLATOR

If you want an instrument which will tell you all that you want to know about tuned circuits, including aerials and transmission lines within the frequency range of 3 to 75 mc., this grid-dip oscillator will meet your demands. Entirely self-contained and employing a minimum number of components, it can be used also as a signal generator, field strength meter, absorption-type frequency meter, transmission line standing wave indicator, transmitter neutralising indicator, CW monitor and phone monitor.

by Raymond Howe

IT is a simple piece of test equipment which cannot fail to have wide appeal. Electronically speaking, it has been, it still is and will continue to be, the simple answer to the proverbial maiden's prayer!

The unit is the essence of simplicity, yet it can save you, over a period, much time and annoyance associated with "cut-and-try" methods. It can open closed doors on such things as the correct length for a certain type of cable to resonate at a particular frequency, or the actual resonant frequency of an aerial or array.

VERSATILITY

A unit can be used to hunt for and locate the frequency of parasitic oscillations in transmitters. As an absorption frequency meter, it can give relative strength readings of harmonic output in various stages of a transmitter. Because the unit itself supplies the necessary energy, apart from the use just mentioned, the circuit under test need not be in operation. This is quite an advantage, particularly in setting-up transmitters.

While its wide and various uses fall, mainly, within the sphere of the transmitting amateur, it has quite an attraction for the home constructor who extracts his interest from short-wave listening.

For instance, by employing the instrument in its basic role, that of a grid-dip oscillator, the tuned RF circuits of a short-wave receiver may be adjusted and the tracking checked, if gang-tuned, without even switching on the power. Later, when the IF and audio portions of the receiver are functioning satisfactorily, the instrument can be used as a simple signal generator to give the RF cir-

founded on such a familiar piece of fundamental theory. Later on in this article, the practical applications of this unit will be covered at some length.

In a practical design, portability is an important feature. Accordingly, the unit operates from self-contained batteries rather than from an a-c power supply. The facility thus afforded more than outweighs the initial cost of the batteries. The B battery drain is very light, being under 5 mA on the average for the battery, and only 25 mA for each of the four small A batteries wired in series-parallel. Furthermore, as the usage is intermittent and for short periods only, replacement can be forgotten for quite a long time.

1.4-VOLT VALVE

The question of battery operation dictated the use of a 1.4-volt valve. The desire to have an upper frequency limit as high as possible suggested that, in addition to other factors, the valve be of the miniature type. As there are no suitable triodes

available in this series of valves, the choice centred upon the 3V4 pentode connected as a triode. We agree that there are more suitable types of valves, but the big drawback is that these are not easy to obtain.

As is the case with all our designs, components are used which are readily available on the supply market. This, also, is why we used a single-section tuning capacitor. Mechanically and electrically, it would have been better to have used a bed-mounting split-stator type; but, unfortunately, such items are not readily obtainable in the size required.

Similarly, we would have liked to have used a coil-former diameter of about ¼in or so to aid, apart from other points, in concentrating the magnetic field of the coil as much as possible. However, little is sacrificed in using the standard 1¼in-diameter size with the appropriate socket.

B-BATTERY

As far as the B battery is concerned, there is but one choice, the miniature 67.5-volt size, if the unit is to be kept to as small a size as possible. For the A supply, four of the 1.5-volt pencil-type torch cells are used, connected in series-parallel. These fit snugly between the barrel of the meter and one side of the case. Two of the next size of torch cells could have been used, one on each side of the meter barrel, but this would have necessitated altering the position of the filament switch. We wanted this switch to be near the tuning control to lessen the chance of the unit being left switched on when not in use.

The point in mind here is that the switch is operated as the right hand moves toward the tuning control and switched off as the hand is taken away. Admittedly, the meter could serve as an off/on indicator, but we have noticed at times that even pilot lights do not serve their intended purpose.

METER

There is little leeway in the choice of a meter. The main point to watch is the depth of the barrel and the length of the terminal bolts. We used a 2-inch meter, although a 3-inch size can be accommodated if you intend making your own case. The terminal bolts were carefully cut down to 5/16in to 3-8in in length, which, together with the meter-barrel depth and the thickness of the B battery, sets one dimension of the case of the instrument.

A swift glance at the circuit of the unit will show that, to quote, "there is nothing in it." Apart from the meter, the B battery, and possibly the valve, most of the components can be found in the average junk-box. As you can see, it is a straightforward oscillator. While the general conditions for oscillation are fairly well known, it is, however, worth a paragraph to review the function of each component.

Associated with the triode-connected 3V4 is a centre-tapped tuned circuit with one-half connected between the plate and filament and the other half connected between the grid and the filament. Because the plate and grid circuits are mutually coupled in the correct phase, the valve oscillates at a frequency determined by the inductance and capacitance, both lumped and distributed, in the tuned circuit. It will be recognised as a form of the Ultraudion circuit.

GRID CURRENT

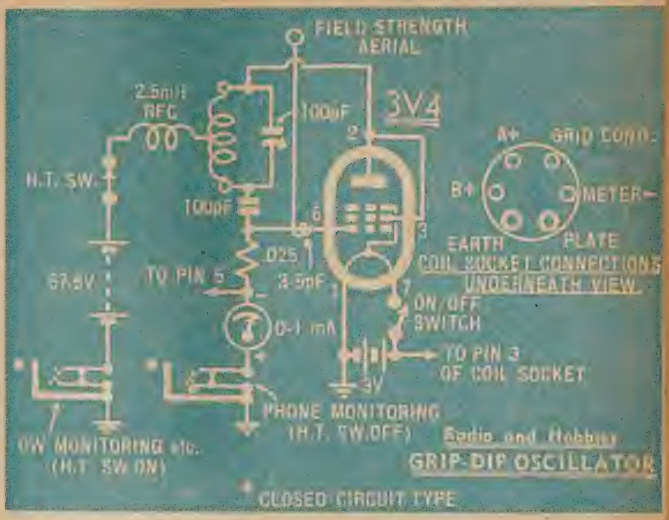
The impulses received at the grid from the plate circuit cause grid current to flow, which charges the grid capacitor negatively. This charge leaks away through the grid resistor, the current registering on the meter connected in series with this resistor. The magnitude of grid current shown on the meter is a measure of the "strength" of oscillation. The steady charge on the grid capacitor provides bias for the valve and sets the operating point on the grid-plate characteristic.

When the oscillatory circuit is coupled to an external circuit resonant at the same frequency, the absorption of power by the external circuit results in a reduction of feedback to the grid circuit. The meter showing grid current, will register this reduction of feedback by a dip in its reading, hence the title "grid-dip oscillator." Of course, there will be a corresponding rise in the plate current of the valve, but the condition in the grid circuit are much more sensitive to changes in load upon the oscillator.

The single-section tuning capacitor necessitated the use of a three-terminal coil. We tried a two-terminal coil with the plate circuit shunt-fed through the RF choke. However, spurious secondary resonance effects tended to give undesirable dips in the grid current as the tuning was varied over the low and the medium frequency ranges, we settled for the slight inconvenience of feeding the HT in at the centre of the coil.

The coil for the highest frequency

CIRCUIT OF GRID-DIP OSCILLATOR



What piece of test equipment could be more simple than this? Note that the phone jacks are of the closed-circuit type. The time constant of the grid circuit is such that no "[illegible]" at VHF should occur.

PARTS LIST

- 1 case 6in by 4in by 3in (with removable base cover).
- 1 67.5 volt miniature battery (No. 467 or similar).
- 4 1.5 volt pencil torch cells (No. 955 size AA or similiar).
- 1 3V4 valve, 1 2in 0-1 mA meter, 1 100pf midget variable.
- 1 reduction drive (about 5½ to 1), 1 insulated shaft coupling.
- 2 Single pole switches, 2 closed-circuit phone jacks.
- 1 miniature valve socket (mica-filled type), 1 6-pin socket.
- 4 1¼in dia plug-in coil formers.
- 1 small 100pf mica, 1 0.025 meg. ½ watt resistor, 1 2.5 mH RFC.

SUNDRIES

- 1 suitable handle for case, knob and tuning scale, small quantity of 20 SWG enamelled wire, scrap aluminium for brackets, 2 2-tag mounting strips, 1 terminal, insulating washers, nuts, bolts, solder, lugs, etc.

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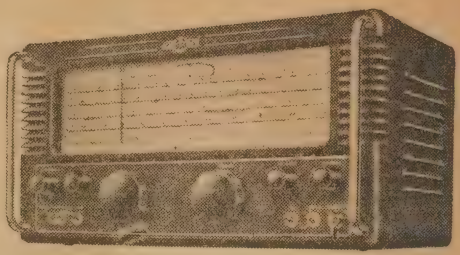

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4R/H.

band can carry a VHF choke, right at the tap, in the coil former or valve base, whichever is used. For the external VHF oscillatory circuit mentioned earlier, a low value split-stator tuning capacitor and a two terminal coil or loop can be used.

TUNING RATIO

With the tuning capacitor having a maximum capacitance value of 100 pf., the largest available in the type, a tuning range of about 2.5 to 1 is obtained. This is quite satisfactory, considering the minimum capacitance value, and it keeps the number of coils down to four.

The closed-circuit jack in the plate d-c circuit permits the insertion of a pair of phones for such work as CW monitoring, transmitter parasitic investigation and heterodyne frequency metering. The B battery switch removes the plate voltage so that the valve acts as an RF diode for phone monitoring, field strength measurements, transmitter neutralisation, absorption frequency metering. For phone monitoring, the phones are plugged into the closed circuit jack in the grid circuit. For the three other uses as an RF diode, the meter will be forward-reading. The tuning scale calibrations will still apply.

The aerial terminal post for field strength measurements is coupled to the grid circuit through a very small value of capacitance. A couple of twists of hook-up wire should be enough.

In taking field strength measurements, a stiff wire aerial of suitable length is attached to the terminal post such that a workable reading is obtained. This will temporarily alter the instrument calibration somewhat, but this is unimportant in this use. Peak the tuning for maximum meter reading while the pick-up aerial length is being adjusted.

GRID RESISTOR

The final remark upon the circuit concerns the value of the grid resistor. In most cases the value shown will be fairly close to the optimum. It was selected such that at the high-frequency end of the lowest range, the meter needle was just moving off scale. However, if the valve which you use is "down" a little, or happens to differ in one way or another from average characteristics, a little variation of the value of the grid resistor will permit full use to be made of the whole meter scale.

You will notice that as the tuning is varied over each range, the meter reading will gradually change. This is quite common in any oscillator when the L/C ratio of the oscillatory circuit is altered. However, the change is gradual, and could not possibly confuse the definite movement of the needle when the instrument is being used for circuit checking.

Coming now to the constructional side, the case measurements are 6in by 4in by 3in deep. The depth is just about 3-8in too short to take a standard 3in handle. We didn't budget for such a handle, as we wanted one which would give protection to the meter face. The one shown on the unit was bent, in the vyce, from 3-8in rod, each mounting face being drilled and tapped. A handle is not an absolute necessity, of course, but the choice is yours.

B BATTERY

The B battery fits crosswise underneath the meter. A piece of cardboard strip at one or both ends prevents sideplay and insulates the terminal clips from the case. A right-angled lip secured to the inside of the bottom cover holds the battery against the rear of the case.

The tuning capacitor is set back from the side of the case by a suitable mounting bracket. The purpose of this is to reduce the lead length to the coil socket to a definite minimum and to allow an insulated coupling to be used on the drive to the capacitor. A ball-type reduction drive lends to smooth tuning and acts as another bearing support. The type used has a reduction ratio of 5½ to 1, which means 2⅔ revolutions of the tuning knob for the 180 degree sweep of the scale pointer.

In the interests of reducing minimum-tuned circuit capacitance hacksaw cuts were made between the pins of the coil socket. It is not worth doing this to the valve socket as the mica-filled type are available and these have fairly good properties.

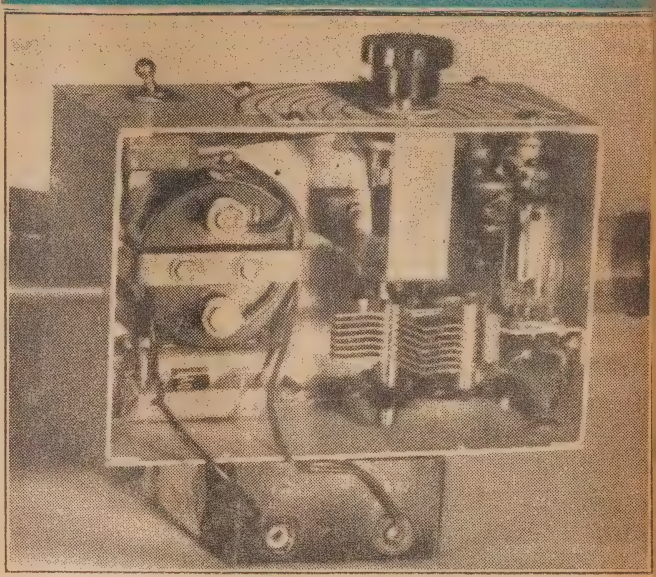
In attaching the valve socket to its mounting bracket, orientate it in such a way as to have the shortest possible leads to the tuned circuit. We arranged it such that the filament pins 1 and 7, are towards the outside lower edge of the bracket. Keep the filament leads away from the components running them down the corner of the case and along the inside to the battery and switch.

RIGID WIRING

It is preferable to use the ¼-watt size, or smaller, for the grid resistor. Similarly, the grid capacitor should be of the smallest physical size obtainable. All of the d-c wiring should be anchored in place by solder lugs attached to convenient bolts or, as we have done, with Scotch tape.

The leads from the tuning capacitor to the coil socket and to the plate of the valve should be of fairly heavy wire from the point of view of rigidity and lead inductance at VHF. Ensure that all soldered connections are good and firm with no "cold" joints. Above all, attack the constructional side of the job with the main idea of mech-

UNDER CHASSIS OF OSCILLATOR



Most of the space is taken up by the batteries and meter. Do not forget to insulate the rotor plates of the tuning capacitor when mounting it on its bracket, and to use an insulating coupling to the capacitor drive.

GRID-DIP OSCILLATOR COIL DATA

3.1mc—7.7mc 32 turns, closewound.
6.7mc—16.0mc 11 turns, closewound.
15.0mc—38mc 4 turns, spaced to ⅜in.
32mc—75mc (approx) ¾ turn at top of former.

All coils wound with 20 SWG enam. on 1¼in dia formers. First three coils started ½in from top of former. Grid end at top. All coils centre-tapped.

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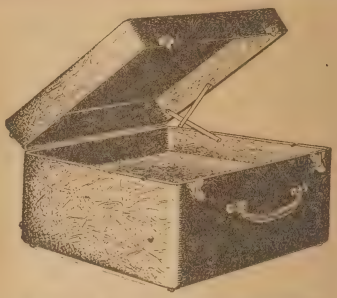

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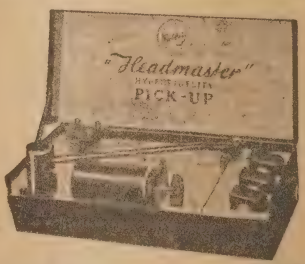

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anical rigidity as there is nothing more exasperating than a "cranky" oscillator or one that is susceptible to changes in calibration with normal handling.

There is nothing special in regard to the coils other than to keep the ends of each coil and the lead from the tap fairly well clear of each other. When completed, it is definitely advisable to give each coil a liberal coating of dope or other suitable insulating covering. It is handy, also, to identify each coil with a code letter and the frequency range, although the difference in the number of turns on each coil is more or less sufficient to prevent any doubt arising as to which is which.

CALIBRATION

Fortunately, calibration does not present any problems. A calibrated absorption-type frequency meter or a calibrated receiver may be used. Assuming the use of the former, loosely couple the unit to the absorption meter and find the upper and lower frequency limits of each coil by tuning the absorption meter until a dip is noticed on the meter of the grid-dip oscillator. Intermediate points can be calibrated by setting the absorption meter to each point and tuning the unit for the dip on the meter.

The average amateur need not be at a loss to discover some means by which the instrument can be calibrated. For instance, at VHF, lecher lines can be used.

In the setting-up of transmitters, all of the initial adjustments to the inductors can be made before the power is first switched on. With tritet oscillator cathode circuits, the actual frequency setting will depend to a large extent on the activity of the crystal and the order of multiplication desired within the stage. Nevertheless, the grid-dip oscillator can be employed to set this circuit in the region where it is anticipated that the final working adjustment will be. Working through from the oscillator stage, then, all grid and tank circuits can be set to the desired harmonic of the crystal frequency.

PARASITIC TRAPS

If any tuned parasitic trap circuits are in use, they can be set to the desired frequency while in place. Of course, such traps can be resonated before being installed, and if not affected by other inductive components when in place, they will hold their resonance setting. Series resonant traps can be initially set on the bench by temporarily connecting them for parallel resonance. Beware at VHF for change in connecting lead length when going from one condition to the other for this test. Do not be misled by stray capacitance in the circuitry masking the frequency setting of the trap. If in doubt, establish a starting point by disconnecting one side of the trap and ensuring that it is on frequency. The Q of a trap should be sufficiently high, however, as not to be affected in this way. In general, where trap-settings are critical, precise adjustments can be made in the usual manner when the equipment is on.

If by using the instrument as a heterodyne frequency meter, parasitics are found to exist in some stage or stages of the transmitter, the equipment can be switched off and the instrument used as a grid-dip oscillator to find resonances at the frequency of the parasitic in various parts of the circuitry. In this regard, check around RF chokes if there happens to be one in both grid and plate circuits of a stage. Also check lengthy leads which can resonate with stray capacitance at some VHF.

LOOSE COUPLING

In all applications of the instrument where frequency determination is desired by watching for the dip of the meter, the coupling to the circuitry under test should be as loose as possible consistent with a workable indication. You will find that even for a good flick of the needle, the coupling will be loose. We have found a noticeable indication when some seven inches away from a tuned circuit. For this reason, where the circuit under test is physical close to other circuitry, it is advisable to make sure that the indication is due to the circuit under scrutiny. This can be checked by watching the meter while a moistened finger is placed on an ungrounded part of the particular circuit. If a change in resonance reading is noted, you can be sure that you're not barking up the wrong tree. Remember that this use of the unit is made without any power being applied to the equipment under test. Before making the finger test at any time, pause and think, just to make sure that the power is not on. With transmitters, death can be so permanent.

A second verification method is to temporarily detune the circuit being checked to confirm the reading. If other coils tend to mask the reading, the offenders can be temporarily shorted out.

For signal generator use the procedure is quite obvious. You will realise that, as the grid-dip oscillator is not modulated, it will be necessary to use some tuning indicator in order to note the effects of the alignment adjustments.

For heterodyne frequency meter work, use as a grid-dip oscillator but with a pair of phones plugged into the jack in the plate circuit. An audible beat will be heard at the fundamental and harmonic frequencies when coupled to a source of RF energy. The actual frequency of the circuit under test is read straight from the dial. Of course, care must be taken not to confuse a harmonic with the fundamental frequency reading.

For CW monitoring, use as a heterodyne frequency meter. You will soon find out how close to the transmitter it will need to be. If necessary, a short pick-up aerial can be attached, but do not forget that this will alter the calibration.

To monitor phone transmissions, switch the B battery switch off and plug a pair of phones into the jack in the grid circuit. In this way, the unit acts as a tuned RF diode detector.

(Continued on Page 81)

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20	H.127	H.128	H.129
40	H.130	H.131	H.132
80	H.133	H.134	H.135
B/C	H.136	H.137	H.138

PRICE 5/6 ea. B/C 6/6

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RF. 81 Silk Honeycomb	1/9
RF. 82 3 PIE 1.7 M/H	4/6
RF. 83 4 PIE 2.5 M/H	4/6
RF. 84 5 PIE 4.0 M/H	4/6
RF. 85 6 PIE 7.0 M/H	4/6
RF. 106 Vibrator Low Tension	4/3

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TYPE	PRICE
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LINE FILTER COIL

TYPE RF.15

PRICE 11/-

FROM THE SERVICEMAN WHO TELLS

THE first was a hard-bitten traveller in men's clothing—I will refrain from the obvious crack about "what else do you think he'd wear?"

He dropped—or placed—an attractive little mantel set on the counter and asked me whether I'd fix up the hum for him. The request was so commonplace that I merely expected to install a couple of new electrolytics and hand it back over the counter.

As it was, I switched the set on and made it play. There was no obvious hum and certainly not enough to worry the average listener. The client, however, had different ideas. He turned the gain back to a mere whisper, poised his ear near the speaker and said "Listen to that."

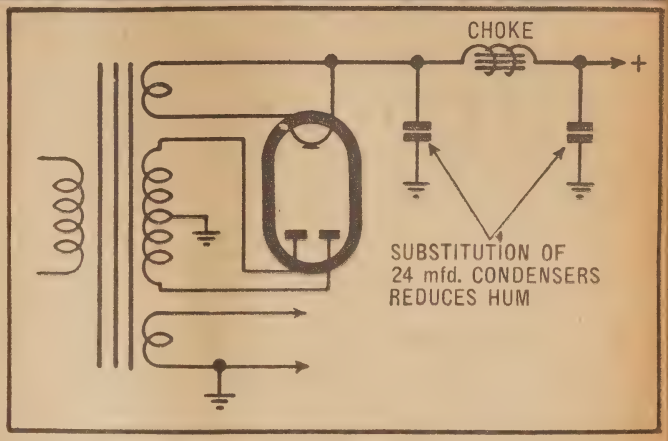
He then explained that a lot of his time was spent in hotel rooms, that he liked listening in bed and he had to have it low and close handy to avoid annoyance to other guests. What a noble creature!

I had to explain that the hum level was really quite normal and that the designer had not anticipated that the set would be used in just that fashion. Even so, most people would still not have complained. Technically, it would need an extra filter choke or some extra condensers to make it completely quiet.

SIMPLE LOGIC

Our friend had not the slightest idea what a filter choke or condenser was, so I showed him an 8 mfd. electro. Not expensive? Then stack 'em in anywhere, but make the set quiet!

Left alone, I figured that the man's contention was quite a logical one and, since he could obviously afford it, there was no objection at all to granting his wish. Practically, it would be a lot easier to install extra condensers rather than another choke, involving mounting holes or brackets.



Extra filter is often a good way to cure hum.

A favorite topic for amateur debates centres round the phrase . . . "the end justifies the means." I haven't made a point of discussing it with clients, but at least two of them apparently believe that the sentiment is justified.

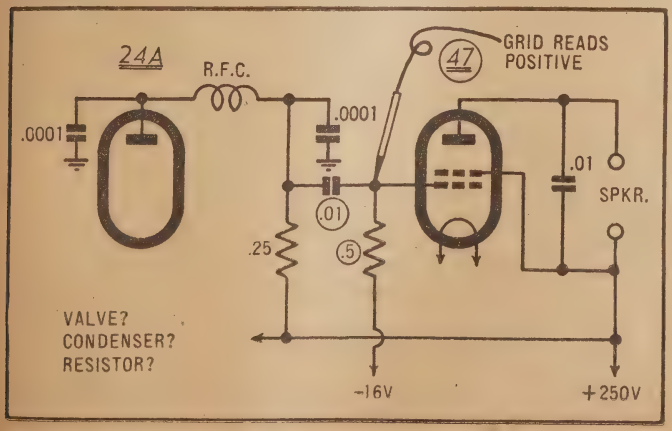
Additional capacitance could be connected on either side of the existing filter choke, either immediately after the rectifier or on the main high tension line.

In the first position, it is necessary to consider valve ratings, since a large input condenser means increased peak current through the rectifier. Detailed data sheets quote actual figures for maximum plate voltage, input condenser value and supply impedance—a figure which involves the whole regulation characteristic of the power transformer. Since only a few privileged folk are in a position to know all these quantities, the rest of us have to be content to "go easy" on the input condenser value when the rectifier is operating under full voltage ratings, heavily loaded and connected to a husky power transformer.

In this case, the voltage and current ratings were well below maximum for the rectifier and I could not imagine the little power transformer having particularly good regulation. It would be quite safe to double or triple the capacitance of the input filter condenser.

As it was, I managed to get hold of a couple of 24 mfd. electrolytics which actually replaced the original 8 mfd. units, and there was no need to string them all over and under the chassis as the client had originally imagined.

The "end" — much reduced hum level—appeared to justify the means in no uncertain fashion.



OLD SETS

The second case concerned an old chap with considerably less assurance and means than the traveller in men's clothing. Oh yes, I worked in the little crack before, didn't I?

The old chap apparently loved to potter in his shed and garden beyond the range of the family radio. "Mother" could listen while she cooked, so why shouldn't he do likewise outside? That's how the story ran. . . .

He had one old set on hand which had long since ceased to function but found that he could get another old set from a crony in equally unserviceable condition. I refer of course to the set, not the crony! Perhaps a young fellow like me

Positive grid in this case meant a gassy output valve.

ould put them together and make ne good one?

Jobs like that take a lot of time ut. on the other hand, old chaps ike that are good talkers and often ass along a lot of business without nowing it. Besides, I wanted to elp him if I could. Yes, I would ave a look at the sets.

His own old set must have been mong the first of the "modern" uperhets, with a string of 2.5 volt and 5-pin valves in the sockets. The chassis, alas, was a mass of dirt nd oozy wax, cans were loose, wires drift, condensers leaking and so n, ad lib. The whole thing had that ncient hopeless appearance which dispelled all thought of it ever working again.

The other set was a very different proposition. It also was an old superhet with similar valves but the components were of ancient but familiar pattern. The wiring was clean and open and, apart from a bit of dirt, it looked no more of a service problem than any other set of the 1931 era.

DUD VALVES

Checking through all the valves revealed three or four "duds" but there would apparently be enough good ones to make this set play.

I duly plugged them in but it took another solid hour's work to get even the first "peep" from the speaker. Those 1931 boys had a lot to learn about making tubular condensers and other small bits.

When music finally did issue forth, it was terribly distorted and obviously a case of something amiss around the power valve. A meter on the grid pin revealed a substantial positive voltage, which could have been due either to a leaky coupling condenser or to the valve itself. Disconnecting the coupling condenser made no difference to the positive grid voltage, although there was clearly 16 odd volts of negative bias at the other end of the resistor. The resistor wasn't open either, because I had previously checked it.

This was nice—a gassy 47 output valve and no replacement other than a new valve. "Pop" wouldn't be very happy about that, in addition to paying my wages.

But wait, the other chassis had an old 45 in the socket. Why not use it? To be sure the gain would be down slightly and the load would be a bit astray but Pop would never know the difference!

It was only a few minutes work to strip the 4-pin socket from the rejected chassis and to swap it over for the 5-pin socket carrying the 47. I swapped the back-bias resistors over, too, replacing the original 400 ohm resistor with one just over 1000 ohms. The new bias would be about 55 volts but there was no electrolytic bypass to worry about across the resistor.

In went the 45 valve, on went the switch and the old set played like nobody's business. It was a trifle distorted at very low volume but then the old anode bend detectors weren't the best in this regard. Sufficient to say that Pop was the happiest man I've seen for many a long day!

The happiest boy around the place was the lad down the street who was allowed to cart off the remainder of the old set. After all, it did have a few resistors and condensers left, a perfectly good 3-gang, a couple of filter chokes and a can full of wax and power transformer. With typical youthful zeal, he'll probably turn it into a "Little Jim" or some such figment of the Editor's imagination.

In lighter vein, I had my leg pulled very solidly recently by a correspondent who wrote in all seriousness to the Editor complaining that I was a blatantly unashamed plagiarist. Ultimately I discovered that this had nothing to do with philosophy or nudism and that a plagiarist was one who "pinched" articles and ideas from one magazine and had them republished in another as his own.

In the words of a well known record. . . . She didn't do it, she says so herself. I didn't do it either.

It turned out that the items listed a couple of issues back had corresponded in detail with cases handled by the reader in the previous month and he wondered by what occult art I had managed to read his memory.

Still talking about letters, the Technical Editor passed on one for a New Zealand reader. The first part is a little bouquet which I must blushingly accept. As for the rest . . .

"I'd particularly like to express my appreciation of The Serviceman Who Tells, and my wonder and admiration at the manner in which he continues to retain his sense of humour, a virtue seldom found in gentlemen of his profession.

"I'd very much like to tell him of the customer whose set was losing its performance. Being the smart type who'd 'tinkered' in his youth with 'wirelesses' he went through the usual performance of tightening the screws in the top of 'those square cans.' This failed to produce any improvement to the set so he 'put a few drops of distilled water in the other two holes' and to his astonishment and in his own words 'she just quit!' "

A SCREW LOOSE

I've listened many times to the tale of "tightening the screws in the square cans." For the uninitiated, those screws are provided to align I.F. transformers and coils and they are set in a particular position before the receiver is sold. They should never be touched except by a person who knows how a receiver should be aligned.

Since they are not mounting screws, there is no need for them to be tight and usual idea is to provide them with a friction spring or to seal them in place with soft wax.

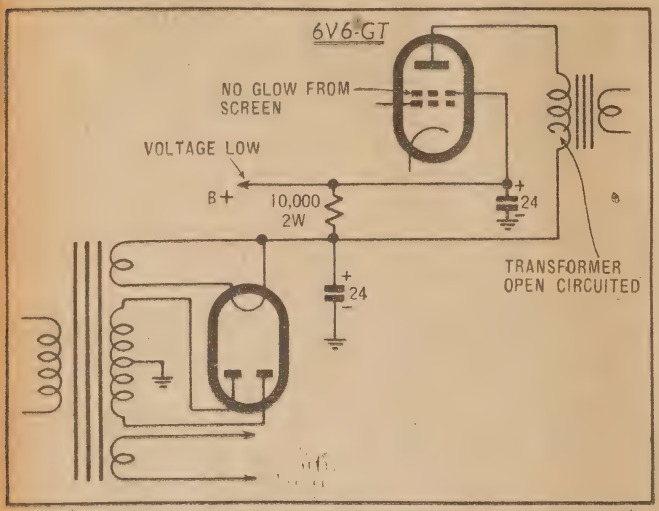
Some modern I.F. transformers, by the way, have deliberately loose threads in the core adjusting screws, avoiding the old trouble of binding. The loose threads and sometimes a small well in the top of the moulding allow the wax to run down far enough to provide a reliable seal.

But don't forget to seal the threads if they are loose, especially in a mantel set. I came across another case this week of a set in which the screws had not been properly sealed after alignment. Vibration from the speaker had gradually wound the cores down till the set was completely out of line.

But where am I getting to? Started off reading a letter and finish up delivering a homily about sealing wax. Homily? Homily? Let it go, the dictionary's up on the top shelf!

The next set was one of the popular ¾ mantel models manufactured by a well known company. The set arrived as dead as the proberbial dodo and the owner announced that, although he had had the set out of the cabinet, he could not make it go.

I am always a trifle wary of sets



An open circuit speaker transformer can cause damage, strife if not quickly repaired.

which have been 'looked at' by their owners ever since I was caught with the man who wired the dial lamp to the 5-volt winding. Easier on globes, you know!

In this case my fears proved groundless, as the set had apparently been put straight back in its cabinet after a superficial inspection.

The set when switched on showed no signs of life, other than the valves lighting up. There was not even a slight hum in the speaker. The high tension voltage measured about 200 volts and at first I thought that this was on the low side, which made me suspect a screen or oscillator plate bypass condenser.

However, a closer inspection showed that the set used a low voltage transformer and no filter choke. The rectifier filament was bypassed with a 24 mfd electrolytic and the plate supply for the output valve came from the same point. The H.T. for the rest of the set and the output valve screen was supplied via a 10,000 ohm 2-watt resistor bypassed with another 24 mfd electrolytic.

The voltage on the output valve screen and the rest of the set should have been approximately 100 volts but measured only 60 volts. Also the 2-watt resistor was very warm, although not actually burning. This also led me to believe that there was a faulty component. Careful checking, however, showed that this was not the case.

Then the voltage measured across the back bias resistor proved to be very low, as though the set were not drawing sufficient current, or there were a partial short across the back bias resistor.

It was only then that I discovered the real trouble. Measuring the H.T. volts again, I placed the prod on the plate of the output valve and found to my surprise that there was no voltage at this point. Further checking proved that the output transformer was open circuit.

This was unusual as the transformer was of the sealed type and these as a rule give very little trouble. The low screen voltage and the hot resistor were obviously caused by the high screen current which would flow in the output valve under these conditions. However, due to the low voltage, the current was not sufficiently high to cause the usual telltale glow of the screen.

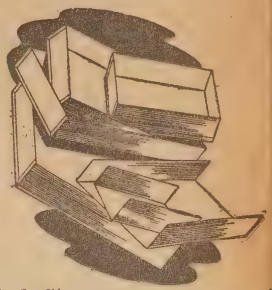
REPLACEMENT

I found on making inquiries that the necessary replacement transformer could not be obtained for two or three weeks and, not wishing to keep the set this long, I started to look around for another suitable type of transformer. I found that a small unshielded transformer of another manufacturer would be ideal, so the old transformer was removed from its case. This was done by heating the wax until the transformer could be pulled out.

The new transformer was then slipped into the can and the whole reassembled on the speaker. The time taken to do this was very little longer than that necessary to drill new mounting holes on the speaker frame. There was no danger of the drill slipping and damaging the speaker cone, and the job looked better, anyway!

ALUMINIUM CHASSI

Easy to Work



8 x 5 x 2½ ..
10 x 6 x 2¼ ..
13 x 7 x 2½ Welded ..
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17 x 8 x 3 ..
17 x 10 x 3 ..
6 x 4 x 2 Open ..
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Here's your answer, Tom!

It's if one bout of transmitter questions were not enough, Tom has come to light with yet another batch. At the present rate of progress we will shoot right past the "ham" radio stage and end up in Parliament —or something!

I AM afraid we will have to gloss over some of your questions, Tom, because they are right outside the scope of these pages. The trouble is, if we introduce a lot of maths and diagrams, many of your mates will turn to the next article and not even try to understand what we are talking about. Take your first question for example:—

How does one work out details of a delta matched aerial for 14,320Kc.?

The formulae for working out the length of a dipole aerial are given in all amateur radio manuals and a

lot of other text books besides. The aerial must be of copper wire, although the exact gauge is not important at 14 mc. At the higher frequencies, when one is likely to use aluminium or duralumin rod or tubing, a correction factor is applied which is also explained at length in the said text books.

The same remark goes for methods of feed and calculation of dimensions to do with a delta match. In the ultimate, however, it is wise to cross-check calculated figures by observing the loading effect on the transmitter.

If a reflector were connected to make a two element beam, what would be the length of the reflector and the distance between the reflector and aerial?

You will find many paragraphs and tables in the handbooks about directors, reflectors and beams, and we cannot possibly hope to answer your question in a few lines.

The reflector is normally about 5 per cent longer than the aerial proper; in other words, about equal to an electrical quarter wave. It can be spaced away from the aerial proper by distances varying from about .1 to .3 of a wave length, the distance having an important bearing on the sharpness of tuning and the aerial impedance. See how complicated it gets?

Fortunately most amateur radio handbooks contain a lot of tables and graphs which relate distance, length, impedance &c., and you should spend a few evenings going through them.

How is the ratio of a class AB2 transformer calculated?

What a horrible question, Tom, to greet one on Monday morning, or, for that matter, any other time or day of the week! There is no simple formula and it is a matter of getting to work with a ruler, slide rule and valve curves.

By means of the said curves or, at the worst, the meagre listed information, it is necessary to "guesstimate" the average input impedance to the Class AB2 grids which draw anything from zero current to substantial current over the input cycle.

Knowing the order of drive power required, one can at the same time select a suitable driver valve and, by inspection of the curves, determine a suitable operating load and the voltage developed across that load at maximum power.

Armed with all this information, it is then possible to select a turns ratio which will provide the driver valve with something like its optimum load, and also ensure sufficient volts at the grids without running the driver into the over-load region. The whole operation is one which involves numerous variable and not-very-clearly stated figures and it is quite a test of skill for the up-and-coming designer.

The driver is invariably a triode or pentode with feedback, which can be relied upon to be tolerant of load variations and to have a margin of power output.

The calculations around a class B transformer are essentially the same as for class AB2.

At 100 per cent plate modulation, the sideband power is said to be 25 per cent of the carrier power. What is it with super-modulation at 100 per cent modulation?

There is no doubt about you, Tom, give you an inch and you take a blinkin' mile!

There is actually no such thing as 100 per cent super-modulation. The idea is to simply increase the outward expansion of the carrier to a point where the modulation envelope begins to produce troublesome distortion on speech. Just what this means in terms of sideband power depends entirely on the design of the transmitter, the design of the receiver and your ideas of distortion.

Sufficient to say that the effective sideband power can be increased two or three times without much effort, and this is equivalent to a lot more than 100 per cent modullation.

Will the "RF" in a final tank be less when it is loaded by the aerial than when unloaded, assuming the absorption loop is maintained in a fixed relation to the tank coil?

Broadly speaking, the answer is yes. You will note that the globe lights much less brightly when the tank circuit is loaded, while there is also less tendency for arcs to develop across the final tank condenser or the neutralising condensers.

In other words, under loaded conditions the peak R.F. volts across

the final plate circuit are reduced, likewise the circulating plate current.

How does one measure plate and screen dissipation of a transmitting valve?

Once again, Tom, it is a matter of "guesstimation" rather than measurement. If a stage is constructed and adjusted properly, it is reasonable to assume that the efficiency will approximate published figures. Then, provided the plate and screen currents are within manufacturers' ratings, the actual dissipation and power output should be within limits.

However, the valve is likely to be overloaded if the current figures are exceeded, if the stage is badly adjusted, if frequency ratings have been ignored and, last but not least, if the valve is used at full ratings as a multiplier.

Where a valve plate shows color under normal conditions, some idea of the dissipation can be obtained by operating it with d-c potentials only, producing the same order of heating and then measuring the plate input. It is a rough and ready method, but is sometimes used.

I recently built a 6-valve receiver and found that the sensitivity was greatly increased by earthing the A.V.C. line. Should this be so?

No, definitely not. The A.V.C. line, in association with any cathode resistors which might be included, should provide the optimum minimum bias on the controlled valves with no signal input. With a back-bias system, earthing the A.V.C. line will cause the valves to draw more than the normal current but it should not be necessary to do this to achieve maximum sensitivity.

We tip that you have a mistake somewhere in the circuit, or alternatively, a faulty component. One of the A.V.C. resistors may be open circuited or a controlled valve might be gassy and drawing enough grid current to increase its own bias and that on the other stages.

Why should the screen voltage of some valves vary when stations are tuned in or when the A.V.C. line is earthed?

Well, it is simply a matter of current drain. Unless the designer has deliberately kept the screen voltage down, the dropping and shunt resistors would be calculated to give the correct screen voltage at minimum bias—that is, in the absence of a signal.

When A.V.C. voltage is developed, as a result of the signal being tuned in, the plate and screen current of the controlled valves is reduced, there is less voltage drop across the resistors and a higher voltage apparent at the screen. It is more obvious when the screen is fed through a simple series resistor but the variation should not upset the performance of the receiver with proper design nor transgress valve ratings.

When you short the bias, just the opposite happens. The screen current increases, and the voltage drops—perhaps fortunately in the interest of the valves.

I have a multimeter and would like to know how to use it to test a receiver circuit.

If you have a full set of voltage ratings for a particular circuit, the job is easy. However, only a few commercial manufacturers provide this information in their service sheets. To do anything more than blindly check figures requires a fairly intimate knowledge of circuit design.

One has to know, for example, that certain valves in the R.F. end need certain screen and plate and cathode voltages, and that some of these voltages will vary with signal.

In the audio end, where resistance coupling is widely used, one has to expect a certain order of voltage drop and realise that high impedance circuits cannot accurately be checked with an ordinary multimeter.

It is necessary to judge whether voltages are low by reason of design or by some unusual condition in the circuit. We know that this sounds completely unsatisfactory and so it is. There is no easy way, Tom, for a beginner to learn all about circuit testing. The only way is the hard way—learning by study and experience the conditions to expect in receiver circuits.

Is it true that a 50-cycle transformer will not operate satisfactorily on a 100-cycle supply? If so, how do they get on about universal vibrator A.C. transformers?

In point of fact, Tom, we have never had to live with a 100-cycle supply and have, therefore, not had an occasion ever to connect an ordinary 50-cycle transformer to it. We would be very surprised, however, if it failed to operate.

A transformer winding needs to exhibit a certain minimum amount of self inductance, depending on the voltage which is supposed to be present across it, also the frequency.

YOU would be next door to a genius if you didn't have some pet problem in radio theory. Keep the "Answer Tom" feature going by letting us have your own list of questions. Address your letter to Radio and Hobbies, Box 2728C, G.P.O. and head it "Answer Tom".

Unless our theory has slipped several cogs, the inductance requirements for a 100-cycle supply will be lower than for a 50-cycle supply. In other words, a 50-cycle transformer should operate very well indeed. It is not likely that heating effects in the iron itself would change markedly between 50 and 100 cycles.

It is just possible, of course, that you are overlooking the line voltage, since at least one big town that we know of, has (or had) a 100-cycle, 110-volt supply. This would obviously not be satisfactory with an ordinary power transformer having a 240-volt primary winding.

No, Tom, the transformer should not worry much about frequency but the primary voltage must be right.

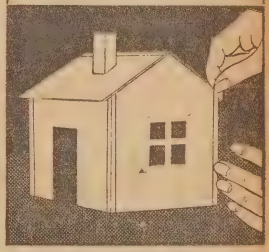
When I tune to any station on my three-valve radio, I usually get another station in the background. What can I do to eliminate the effect?

We take it from other comments that your set is not a superhet but a conventional regenerative type. In this case, the selectivity will be strictly limited and it is a matter of

(Continued on Page 79)

It's child's play with 'DUREX' TAPE

When toys are broken and damaged, children can mend them quickly and simply with "Durex" Tape.



Junior builders use "Durex" Tape to speed construction of their model houses. "Durex" Tape is excellent for door hinges — and windows.

Handy Plaid Dispenser with
300 ins. ½-in. TAPE . 2/6
150 ins. ½ in. TAPE . 1/3
Also a Heavy-Duty Dispenser at 15/- plus tax, and a Desk Dispenser at 12/- nett.
Tape extra.

SEALS WITHOUT MOISTENING
TRADE MARK
DUREX
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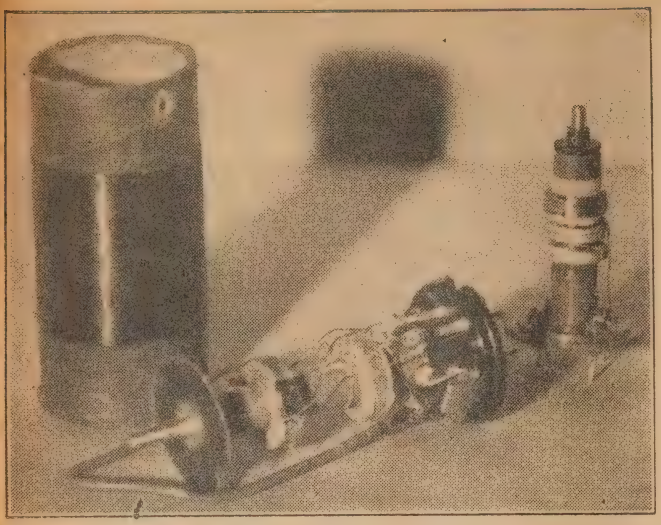


The large coil at the left is of the type used in a crystal set. At the right is a modern aerial coil. Both the aerial coil and the I.F. transformer (horizontal) are normally provided with close fitting shield cans. The efficiency of the coils has a major effect on the "Q" of the tuned circuit.

WHAT IS SELECTIVITY?

We often use the word "selectivity" in technical discussions, but what exactly does it mean? How is selectivity obtained and why are some sets better than others in this important characteristic? Read this special article and you will learn the answers to these important questions.

by Maurice Findlay

WHEN comparing the performance of two receivers, two vital factors have to be considered. The first is the relative ability of the receivers to amplify weak signals and make them audible. This is referred to as sensitivity. The second is their relative ability to separate two stations which are closely situated with regard to frequency. This is known as the selectivity.

There are, of course, other factors to be considered before we could say one receiver was better than another: signal to noise ratio, fidelity, electrical stability and mechanical stability are some of these.

DESIGN FACTORS

An engineer, designing a receiver, must consider all the things we have mentioned, and often a few more special problems peculiar to the particular set.

The history of radio development over the last 20 years is very closely linked with the search for greater selectivity in receivers, to cope with the ever-increasing number of stations on the air. Even up to the present day, the need for greater selectivity and methods of employing high selectivity are the subject of constant research for some radio services.

SIMPLE CIRCUIT

Other than the rough definition of selectivity we gave in the first paragraph, it is rather difficult to state concisely what selectivity is and to give the reader a picture of selectivity on which he can focus his mind. However, it is just this we hope to do in this article. To achieve our purpose, we must go back to the elementary tuned circuit and consider its characteristics with regard to selectivity.

On Page 43 is the theoretical diagram of a simple device for selecting a band of frequencies. It consists of conderser connected in parallel with coil. A complete analysis of this selecting device, or tuned circuit, is very interesting, but is beyond the scope of what we wish to cover in this article. For our purpose it will be sufficient to consider only one of its properties.

If the output of a generator is coupled into a tuned circuit and the frequency of the generator varied, an instrument capable of measuring the potential developed across it will show that one particular frequency is favored. As the frequency of the generator is varied slightly either side of the favored, or resonant, frequency, the meter will indicate that slightly less voltage is developed.

PARALLEL CIRCUIT

With a calibrated signal generator and voltmeter it is possible to draw a resonance curve for the tuned circuit. The usual practice is to mark the frequency on the horizontal axis and the amplitude on the vertical axis of the graph. From this graph, the engineer can judge the performance of the circuit.

If the sides of the curve are steep and close to the centre line, the circuit is selective, and vice versa.

A parallel tuned circuit, as illustrated, is the basis of a simple crystal radio set. With a crystal set, the generator is replaced by an aerial and earth system, which feeds all the available signals, at a variety of frequencies, into the tuned circuit. The tuned circuit selects one of these signals and passes it on to the detecting and reproducing section of the set.

If you return to the graph we just mentioned, you will note that frequencies close to the resonant frequency, on either side of resonance, will be passed with very little attenuation. As the separation from resonance becomes greater, so does the attenuation.

BANDWIDTH

The selectivity of the tuned circuit can roughly be defined as the minimum frequency separation between the off-resonant signal and the resonant signal required before the interference from the off-resonant signal is negligible. The greatest amount of interference which can

be considered negligible differs with circumstances, and, when discussing selectivity, engineers usually quote both the bandwidth and the attenuation.

If we fix some figure of attenuation, for the purposes of discussion, the bandwidth of a tuned circuit depends on two factors. The first is the resonant frequency of the circuit, and the second is its efficiency factor or "Q."

The bandwidth of a circuit adjusted to resonate at a frequency of one megacycle (given in cycles or kes.) would be a good deal less than the bandwidth of a circuit of the same efficiency adjusted to resonate at 10 megacycles. If the circuits are at the same frequency the bandwidth depends only on the "Q."

LIMITING FACTORS

There are several factors which set a practical limit to the "Q" value of a tuned circuit and where better selectivity is required than a single tuned circuit can provide, the engineer must look for another approach.

About the simplest method is to combine the effects of two or more tuned circuits, as shown in Fig. 3. For instance, it may be desired to receive a signal on a frequency of 1 mc. and exclude an interfering signal on a frequency of 1.02 mc. (20,000 cycles away). If a single tuned circuit will attenuate the interfering signal 10 units, then two similar tuned circuits, appropriately connected, will attenuate the interfering signal by 20 units. (Strictly, this refers to a particular type of unit, but this does not affect the discussion.) Three, four or five or more such tuned circuits can be combined until the required selectivity is obtained.

CIRCUIT "Q"

Then, again, the efficiency, or "Q" factor, of a single tuned circuit can be improved artificially by feeding energy back into it after the energy has been amplified by a valve. The amount of the energy fed back is made variable, so that it can be adjusted to make up almost all the losses in the tuned circuit, and thus greatly improve the "Q."

This method is commonly known as reaction or regeneration.

Both of the methods we have mentioned can, and have, been used to improve selectivity. However, both have disadvantages which has caused them to be superseded in all but simple receivers.

To obtain sufficient selectivity for modern conditions, by simply combining the effects of tuned circuits at a signal frequency, a great many such circuits are required. If it is to be possible to tune the receiver to a number of stations, serious mechanical problems are introduced. It is either necessary to adjust each circuit individually or "gang" the tuning components so that they can be operated by a single control.

Both methods are inconvenient. The latter was, in the past, considered practicable where the number of variable tuned circuits was limited to less than about four. However, even four tuned circuits at the signal frequency do not provide sufficient selectivity for a modern receiver.

Regeneration tends to be rather difficult in adjustment and nowadays is used only where it is desired to obtain good performance from very simple and inexpensive receivers.

The setting of the regeneration control has to be revised each time the receiver is tuned to a different frequency and the operation of a receiver which depends on regeneration for its performance can only be carried out satisfactorily by someone with some technical background and a desire to fiddle with the thing.

A good many of the problems of selectivity were solved when the superheterodyne receiver was invented. A superheterodyne receiver includes a converter section, the function of which is to change all incoming signals, irrespective of frequency, to a constant frequency. This constant frequency, except in very special cases, is lower than the signal frequency and is usually called the intermediate frequency.

REGENERATION

At this lower frequency a circuit with a certain Q value will have a smaller bandwidth than a circuit with the same Q at the signal frequency. Added to this advantage, a large number of tuned circuits can be used without introducing any great mechanical difficulties because they are tuned to a constant intermediate frequency.

We will not discuss the operation of a superhet receiver in detail in this article. However, it is desirable to have a general idea of how a superhet works so you can understand the rest of the discussion.

A superhet receiver includes an oscillator section which generates a signal which is adjusted so that it always differs from the desired frequency by an amount equal to the intermediate frequency. This does not introduce any serious problems in practice.

If, for instance, the intermediate frequency is 500 kcs and it is desired to receive a signal on a frequency of 1.5 mc (1500 kcs), the oscillator section will be required to tune to 2.0 mcs. The signal energy from the aerial and the energy from the local oscillator are mixed in a special mixer valve which produces the third frequency by a phenomenon known as heterodyning.

A fourth frequency, the sum of the signal and oscillator frequencies (2.5 mcs) is also produced by the hetrodyning process, but this does not interfere with the operation of the receiver. Actually, the first tuned circuit which appears after the mixer valve rejects all but intermediate frequency.

SUPERHET CIRCUIT

This is not a very difficult task to impose on it because all the other frequencies appearing at the output of the mixer valve are well removed from the intermediate frequency in most cases. In addition, it is assisted by subsequent efficient tuned circuits which are interposed between the intermediate amplifier stages.

Incidentally, besides giving an improvement in selectivity, the intermediate frequency permits more efficient amplifiers so that a fewer number of stages are required to give a certain gain figure.

The superheterodyne principle has one main disadvantage. It, as in the case we mentioned previously, a signal at 1.5 mc is being received and converted to 500 kcs by beating with the local oscillator at 2.0 mcs, the local oscillator will also be able to beat with a signal of 2.5 mc to produce the intermediate frequency.

Thus, any superhet will respond to two frequencies if some selecting device is not included in the input circuit.

These two frequencies are separated by twice the intermediate frequency. In the case quoted, even one tuned circuit is capable of attenuating the extraneous, or image, signal effectively, since in terms of percentage, they are widely separated.

If, however, the desired signal is

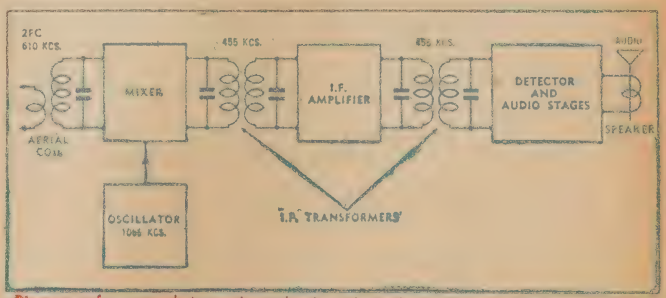
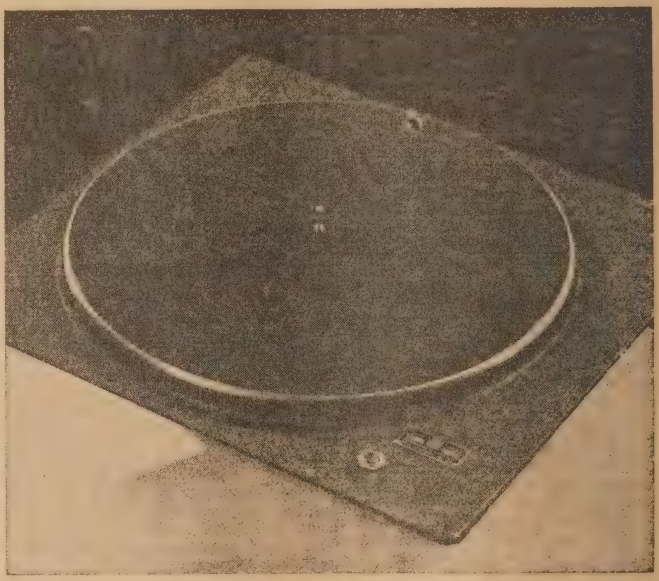


Diagram of a superhet receiver showing the selective circuits. Most of the selectivity is contributed by the I.F. transformers. The tuned aerial coil prevents "image" reception.

SCOOP FOR RECORD FANS!

New-Type BRS Super-Silent Gramophone Turntable

A 2-SPEED PROFESSIONAL-TYPE UNIT, IT ELIMINATES ANNOYING "WOW", "FLUTTER", AND "RUMBLE" NOISES.



Standard turntables, mass-produced for domestic use, can rarely do the job that enthusiastic record fans demand. In view of this, Byer Industries have developed "T25", a professional type turntable for amateur use, available with or without pick-up. The T25 will rotate at constant speed. Because of this, the "wow", "flutter", and "rumble" noises so often found in ordinary turntables have been completely eliminated. The wide margin of reserve power of the motor, and the inertia of the cast turntable overcome the common tendency to slowing down on the heavier passages and more violent transients. The motor, mounted on floating buffers, is synchronous and gives constant correct speed, at either 78 or 33⅓ R.P.M. This means that when the new Microgroove discs arrive in this country, T25 will be the ideal turntable. These features combined with the close tolerances held throughout manufacture ensure silent, efficient operation, as well as long service life.

T25 IS BETTER STILL WITH BRS LIGHTWEIGHT PICK-UP

While you can effectively use an ordinary pick-up arm on the T25, even finer reproduction is obtained with the "B.R.S." moving iron pick-up. **Features include:**

- **Adjustable needle pressure.**
- **Arm shape designed for optimum tracking and "pull in" force.**
- **Ball bearing movements.**
- **A design that cannot pole, removing the necessity for a centring device that must be maintained in accurate adjustment.**
- **Good frequency response and low distortion.**
- **Output level of .2 volts R.M.S. max., from standard discs.**

If you want a turntable and pick-up that's better than "run of the mill" equipment, you must have a new Super Silent B.R.S. Unit. Write direct or call on the Manufacturers, or your local State representative. A T25 unit will make your listening more enjoyable whatever the records.

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on a frequency of 20 mcs, the high frequency oscillator will be required to tune to 20.5 mcs and the image frequency will be 21.0 mcs. In terms of percentage, 21 mcs is very close to 20 mcs, and the attenuation of a conventional tuned circuit resonated at 20 mcs to 21 mcs is not sufficient to suppress the image. Relatively inexpensive dual wave receivers are constructed along the lines we have just mentioned and simply ignore this shortcoming on the high frequency bands.

Better quality dual wave receivers include two tuned circuits before the mixer valve and the image response is reduced in proportion. The two tuned circuits are usually coupled by an RF amplifier stage which also benefits the receiver by improving the gain, signal to noise ratio, &c. However, that is another story.

IMAGES

In discussing the intermediate frequency, we mentioned a figure of 500 kcs to avoid complicated mathematics. The usual figure is actually 455 kcs. As a matter of interest, the authorities concerned have taken steps to have the 455 kc channel kept clear of stations so that there will be no difficulties about interference due to signals being fed directly into the intermediate channel.

While reading our comments on image signals in relation to signal frequency and intermediate frequency, it will possibly have occurred to you that the separation of the signal and image frequencies can be increased by increasing the intermediate frequency, since the image is separated from the signal frequency by twice the intermediate frequency. The signal to image ratio is then improved.

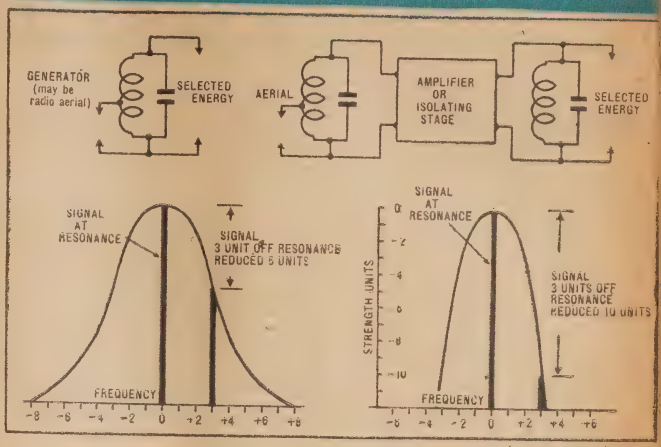
A high intermediate frequency is often used in receivers intended for high frequency work and which must have good image rejection. At frequencies above about 15 mcs. it becomes difficult to obtain good image rejection when the IF is 455 kcs. Receivers for these frequencies may employ an IF of 1.6 mcs. or 2.0 mcs. or some similar figure.

DOUBLE SUPERHETS

In such cases the selectivity obtainable with a given number of stages is, of course, less than can be obtained with the same number of stages at 455 kcs. To overcome this difficulty, certain advanced communication receivers have two IF channels. The two channels are coupled together by means of a second local oscillator and mixer valve. This second oscillator need not be variable and in many cases a quartz crystal is used to control its frequency.

Quartz crystals have similar properties to the tuned circuits we have already discussed. However, their "Q" factor is very much higher than that of a tuned circuit and, more important in the case of oscillators, they are able to maintain their frequency accuracy within very close limits.

CIRCUIT RESPONSE CURVES


GENERATOR (may be radio aerial)
SELECTED ENERGY
AERIAL
AMPLIFIER OR ISOLATING STAGE
SELECTED ENERGY
SIGNAL AT RESONANCE
SIGNAL 3 UNIT OFF RESONANCE REDUCED 5 UNITS
FREQUENCY
-8 -6 -4 -2 0 +2 +4 +6 +8
SIGNAL AT RESONANCE
STRENGTH UNITS
0 -2 -4 -6 -8 -10
SIGNAL 3 UNITS OFF RESONANCE REDUCED 10 UNITS
FREQUENCY
-8 -6 -4 -2 0 +2 +4 +6

In the upper left-hand corner is the theoretical diagram of a simple tuned circuit. Directly below it is a typical response curve. The response curve when the selectivity of two such circuits are combined is shown in the lower right-hand corner. We have used arbitary units for both strength and frequency.

The frequency of the second IF channel may be 455 kcs., or, where very good selectivity is required, a frequency such as 175 kcs. could be used. For receivers designed to be used in the crowded amateur bands it is sometimes desirable to use a second IF channel of the order of 50 kcs. in order to obtain the required degree of selectivity. In the case of a 50 kc. second IF channel it is a simple matter to reduce the bandwidth of the receiver to a matter of a few kilocycles.

AUDIO ATTENUATION

The reduction of the bandwidth of a receiver to such small figures has another important effect besides increasing the sharpness of the tuning: it causes the higher modulation frequencies on the carrier wave to be attenuated. There is insufficient space in this article to discuss this matter, but the statement can be accepted, since its truth is easily demonstrated in practice.

In the case of a broadcast receiver, where it is desired to have good fidelity of reproduction, a certain minimum bandwidth must be provided. In the case of a communications receiver, it is largely a matter of how much selectivity can be used without making the signal unintelligible.

For morse code signals, where the carrier is unmodulated and the intelligence is conveyed by switching the carrier on and off with a "key," the degree of selectivity which may be used is very much greater. In such cases the selectivity obtainable from an IF channel in the order of 50 kcs. or so can be most beneficial.

The extremely high "Q" obtainable from a crystal can be used in a special filter circuit to provide high selectivity. This method has frequently been used in the past in high quality communications type receivers.

A typical crystal filter will give good attenuation even 100 cycles either side of its resonant frequency, when adjusted to the most selective position. Such selectivity can mean all the difference between a signal being readable or unreadable when an operator is copying morse code signals in a crowded band.

The art of communicating in crowded frequency bands has advanced considerably in recent years. The radio amateurs, living up to their tradition of conquering difficulties, have made good use of their relatively narrow frequency allotments and in doing so have developed devices and techniques for overcoming the problems of interference. Commercial radio, too, although the urgency in its case is not as great, has made many contributions to the art.

SUPER-LUBRICANTS FROM CHEMICALS?

Fluorocarbons, a versatile new family of chemical compounds, show broad promise of solving many industrial problems. One important application will be as lubricants so stable they will permit construction of engines impossible at present because no known lubricant could withstand their pressure and friction. Other members of the chemical family will be used in anaesthetics, insecticides and germicides. Fluorocarbons are similar to hydrocarbons except that the hydrogen is replaced by fluorine. The hydrogen is the point of chemical attack in such compounds. It has been dangerous to make fluorocarbons in the past because free fluorine is the most active of all elements.

So popular has the miniature range of coils and I.F.'s made by "Q. Plus" proved, that many people have asked whether we make a standard size coil range.

Yes! Just as the "Q. Plus" miniature range offers the only complete line of miniature coils, etc.—likewise our standard size range covers all needs.

As in the past our advertisements have concentrated on miniature products, we now propose to let you know of our larger counterparts.

"Q. PLUS" STANDARD COILS AND I.F.'s

I.F. TRANSFORMERS

Type No. IF 8 & 9—Our star performer! Specially litz wound with iron dust surrounds silver-mica condensers, low loss base—just the thing where high gain and selectivity is required. No. 8 for first position, No. 9 for second position .... **14/9** ea.

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Type AC4 Aerial. Type RC4 RF. A highly efficient progressively wound litz coil with inbuilt top coupling condenser .... **8/9** ea.

Type AC5 Aerial. RC5 RF. Again our star performer; An iron dust potted litz winding offering exceptional performance, low loss base, inbuilt top coupling condenser, etc., etc. .... **9/6** ea.

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AUBURN, VICTORIA

Noise From Strip Lights

SOME who use fluorescent lighting may have experienced an annoying kind of interference with radio (and television) reception. I write "May have experienced" because it by no means follows that you are bound to have such interference.

Till a short while ago the whole business was rather puzzling, but recent research has given some interesting answers. It has been found that the trouble is caused by only a small proportion (about five per cent) of new tubes, though others which were blameless in their youth, may become interference producers after considerable service.

It is, as a rule, quite easy to discover whether or not a particular fluorescent tube is responsible for either radio or television interference. Switch on the fluorescent light while the set is working, noting the time. If the tube is to blame, interference will be noticed from 5 to 15 minutes later. Switch off the fluorescent tube. If the trouble ceases instantly the tube is guilty.

It is, in actuality, falling into oscillation and radiating fairly strongly.

When you have a tube that behaves this way, take a look at the heaters through the narrow areas of clear glass (if any) at the ends. On the coating of one of the heaters you will find a bright spot.

TAPPING TUBE

Tap the tube sharply and the spot will disappear, together with the interference. Both, however, return after a time. So far, tube manufacturers do not know exactly how or why the condition is caused, or how to prevent it from happening. They attribute it to local "poisoning" in the heater coating.

One British firm specialising in interference suppression has brought out a small device which completely eliminates the interference caused by an oscillating fluorescent tube. Cylindrical in shape and measuring about 2¼ inches by 1 inch in diameter, it is easily fitted inside the casing of the ballast unit.

At Radiolympia, hundreds of fluorescent tubes were in use, but there was no interference in any of the audio or vision demonstration rooms—not after the first day, that is.

Rather surprised, I made some inquiries and learned that the Radio Industry Council had insisted that every fluorescent lamp in the show be fitted with the gadget described.

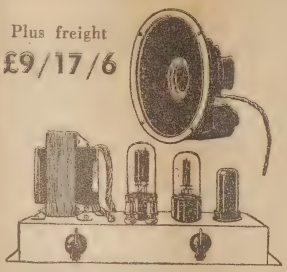
On the opening day there was some interference, whose source was soon traced to one stand. Suppressors had been fitted to all its lamps, but examination showed that the electrician had done the job according to his own ideas and with nonchalant disregard of the makers' simple instructions. — (Major Hallowes, "Radio-Electronics.")

£31/-/- FOR THIS 8-VALVE DUAL-WAVE RADIO

Here's Value only to be found at Radio House. This ready-wired and tested chassis is complete with valves and 12" Rola Speaker.

Complete in every detail, it's easily fitted into your radio cabinet and can be supplied with a polished wood front panel. Ideal for overseas short-wave reception, fitted with Phono pick-up terminals and has tone controls for treble and bass boost.
DIMENSIONS: 16"w. x 10½"d. x 9"h. Panel 16"w. x 10"h. Weight, packed in crate 63lbs.
Front view with panel attached.
With "Plessey" Record Changer .. £39/10/-

Plus freight
£9/17/6



POWER AMPLIFIER — 240 VOLT A.C. MAINS OPERATED

3 Amplifier with 6" "Rola" suitable for amplifying in conjunction with a phono pick up—3 watts output Size unit without speaker 9" x 4" x 6". Weight 8lbs.

5 valve £17/10/-

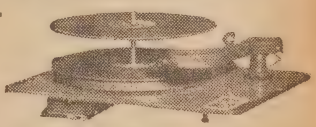
5 VALVE PORTABLE RADIO SET

5-valve b'cast model complete with batteries and valves, housed in beautiful leatherette carrying case **£19/10/-**
This set is suitable for country districts where reception is difficult, as it is super sensitive. 4-Valve B/C £15/15/-

240 VOLT AC COMPLETE WITH MOTOR AND PICK-UP

REDUCED FROM **£18/10/-**
TO **£10'17'6**

It's a Special Purchase — but hurry before they go!
The Plessey British-made record changer is second to none. Special features are automatic stop, automatic cut-off after playing last record—will take eight records, either 10" or 12", grouped or intermixed.



SPEAKER PURCHASE

"Magnavox" 12" Permag. speaker **30/-**
or 33/- posted.
"Magnavox" 6" dynamic speakers, 1500 ohm field, each **15/-**
While they last. Postage 2/6.

Just Landed from U.S.A. "General Industries" Green Flyer Phono Motors. 2-Speed 78-33 R.P.M. £16/12/6
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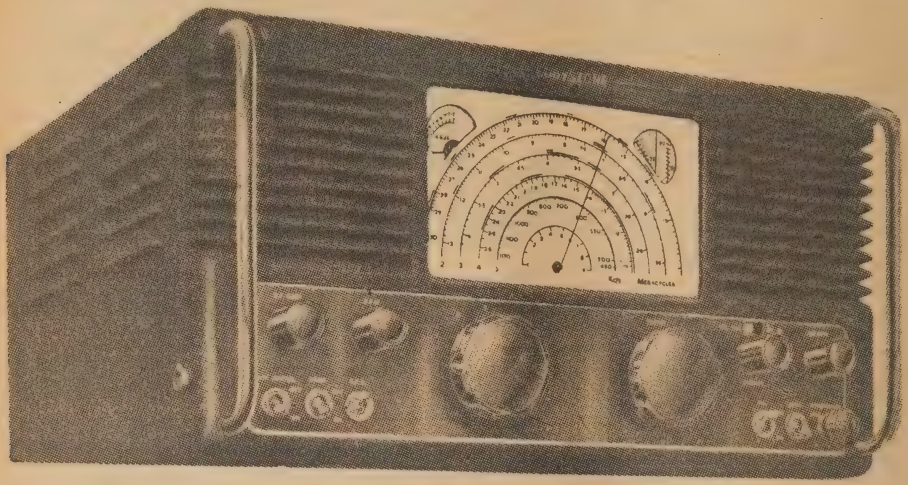
British High Grade Communication Equipment

The Eddystone tradition for quality workmanship is fully upheld in the wide range of Eddystone receivers, embodying years of experience in the design of short wave equipment.



Every Eddystone receiver is robustly constructed and thoroughly reliable in service. All materials are of best quality, and the practically all-metal construction, combined with tropicalised components, make Eddystone receivers suitable for use in any climate. In all parts of the word Eddystone receivers continue to give outstanding results.

EDDYSTONE MODEL 680 DE LUXE (as illustrated)

A new 15 valve professional communications receiver of advanced technique.
Special features include:

Continuous coverage, 30 Mc/s to 480 Kc/s.
Two radio - frequency stages.
Two I.F. stages.
Crystal filter.
Push-pull output stage.
Variable Selectivity.
"S" meter
Noise limiter
Stabilised HT voltage to oscillator, etc
A.C. operation.

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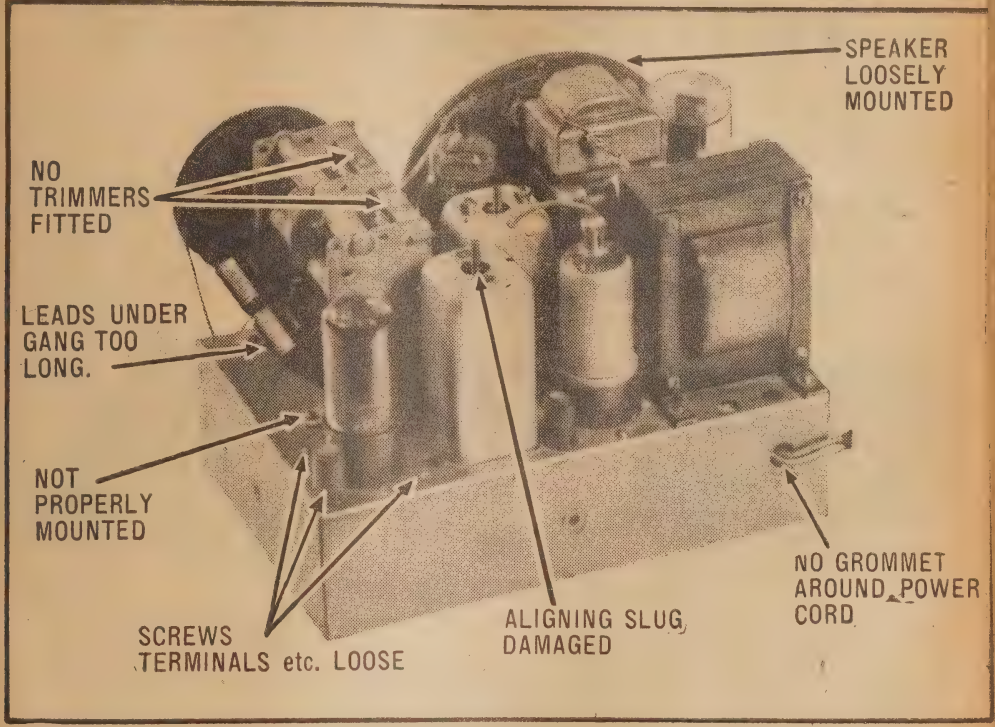

What mistakes does a young constructor make when he builds his first set? To find out, we had a good look at a "Little General" put together by a 15-year-old student. He won't mind if you profit by his experience.

THE point which struck us most forcibly was that our young friend had been very anxious to get the set going and had taken a few obvious short cuts to achieve this end. Who are we to criticise, for we've done the same thing many times.

But short cuts aren't a good thing when you're building a radio set or anything else for that matter. The needed holes have to be drilled in the long run, the soldering cleaned up, the parts made firm, &c., and the result after "cleaning up" is never as satisfactory as if the job were done properly in the first place.

PLANNED LAYOUT

In a small set particularly, it is important to plan ahead where all the parts are to go—though this isn't always easy for the new constructor A coded photograph of the original set is, of course, a wonderful help. Failing that, you can work out and sketch a layout for yourself. Preliminary planning will obviate the difficulty of having too many parts in the one place.

The constructor of this set had failed to appreciate the need for such planning with a result that a lot of parts were crowded together in one section of the chassis while other sections were relatively bare.

Some parts, of course, should go close to the valves they serve, particularly in the RF end, but others, like electrolytic condensers, can be put in spots where they are least likely to cause complication.

LOOSE BOLTS

However, to get back to our story, the job of initial assembly had not been done paricularly well and quite a few of the mounting bolts were little more than finger tight. It is particularly important in a mantel set to screw everything tight, since the vibration of the speaker can easily shake things loose after a few weeks use. Worst of all, nuts and bolts are often obscured by other parts, so that it becomes quite a job to make them really tight again. So don't spare the plyers or box-spanner on the nuts and use plenty of pressure on the screwdriver. To be doubly sure, it is an excellent plan to put lock washers under every nut in the set.

The worst single feature in this set was the mounting of the gang condenser, which had apparently been supplied without brackets. Even if they had been supplied, it is doubtful whether they would have solved the problem entirely, because the gang was non-standard type and new holes would have had to be drilled, anyway, in the chassis.

As it was, our young friend had hacked one odd-shaped bracket from a piece of aluminium which held the gang rather shakily to a single hole which was already drilled in the chassis. As a result, the condenser rocked and swayed crazily every time the chassis was moved.

This kind of thing is just not good enough, because movement of the gang created noise and made the set completely impossible to align. Every component must be rock steady on the chassis, even if it does mean a few hours extra work making brackets, drilling holes and so on.

LONG LEADS

To make matters worse, the leads from the gang to the coils were extremely long and run through the same small hole down past a whole lot of other wiring. It was not surprising, therefore, that when the set was

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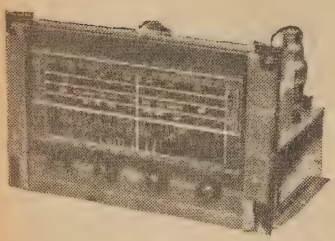

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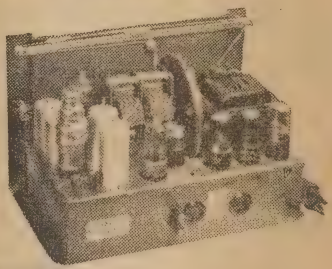

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subsequently switched on, it proved to be unstable.

It is usual to mount the coils quite close to the respective gang sections and the leads must run by the most direct route. In this case, it would have necessitated drilling a couple of small holes to allow the leads from the stator plates to drop straight through the chassis to the coil terminals underneath.

Our young friend had either not bothered to do this, or had overlooked the necessity for the gang leads until after it was mounted in place. Not that we can be too hard on him, of course, having done the same thing ourselves in younger days.

USE GRID CLIPS

The whole point was that ultimately the gang condenser had to be removed, brackets made, new holes drilled and leads attached — a job which was made much more difficult by the fact that the underside of the chassis was well-filled with wiring and components.

Incidentally, the lead from one section of the gang to the converter grid cap had been soldered to the valve instead of being made by means of a grid clip. This is a very unwise procedure, since it is likely to crack the glass, quite apart from the risk of loosening the grid cap. To be sure, the manufacturer solders to the cap but, if he cracks the glass in so doing, that is his look out. If you crack the glass, it is quite a different thing!

Rather than resort to this extreme in the absence of a grid clip, make up a substitue by winding a scrap of tinned copper wire around the cap.

The next point we noticed was that one of the adjusting slugs in an I.F. transformer was pushed down almost flush with the top of the can. Another young player had been trapped!

SOCKET CARE

When turning a chassis over for wiring and inspection, always look to see what it rests on. If the weight is taken by a corner of the power transformer, a husky coil-can or such like, no trouble will result. However, if the inverted chassis rests on the adjusting slug of an I.F. transformer, the weight may easily damage the thread and make subsequent alignment impossible.

By the same token, too much weight on a valve can push it sideways in the socket and either distort the contacts badly or, in the case of an octal valve, break off the locating spigot. Finally, do not forget to check the dial mechanism, which can easily be bent out of shape if too much stress is placed in the wrong quarter.

In this case, fortunately, the I.F. transformer slug was located by a piece of spring wire running in the thread, so that no permanent damage was done. Our young constructor was just "plain lucky."

Then we found that he had forgotten to install trimmers across each section of the tuning gang. These are definitely necessary for alignment purposes.

Our young friend had gained the impression that no trimmers would be necessary, seeing that the coils were equipped with variable iron slugs. In point of fact, the iron slugs allow adjustment to be made at the low frequency end of the band and, therefore, do much the same job as did a variable padder in the days before iron slugs were thought of.

Trimmers are still necessary to peak the circuits at the high frequency end and, if they are not fitted to the gang, they must be attached separately to it or to the associated coil. The plate which touches the adjusting screw should always be connected to the earthy side of the circuit to avoid having the alignment altered each time the trimmer is touched with a screwdriver.

The wiring had been done with modern plastic hook-up, which is hardly the best material to offer a beginner. Too much heat on the wire melts and splits the covering which peels back and gives a "messy" appearance, in addition to the risk of producing a short circuit.

PLASTIC HOOKUP

There is only one way to handle plastic hook-up wire successfully. Cut the lead to length and trim the insulation by running a razor blade or sharp knife around the wire about ¼" from the end, but not so deeply that it cuts the wire itself. Slip off the surplus insulation, moisten with flux and tin the wire quickly, using a clean iron. Then tin the slug to which the lead is to be attached and while the solder is still hot, slip the lead into place and hold the iron on to the joint just long enough to make the solder flow smoothly. Any more heat than this, or repeated alterations to the wiring, will gradually reduce the insulation to a very untidy mess.

We already had something to say about the need for layout planning and how it can contribute to the neatness of the job. Try to find a definite spot for every small component and make the leads short enough to hold it firmly in place. There is nothing so unsatisfactory as a chassis full of components which simply hang loosely in the wiring. If you find that several components have to be joined together with no solid anchor-point to keep them down, provide one by mounting an insulated pillar beneath the chassis carrying a solder lug at the free end.

BETTER NEXT TIME!

We admit that all this adds up to what might seem a condemnation of a beginner's efforts. However, it was his first attempt at set-building and there is no doubt that the second attempt will be much better.

If our little story of his experiences is a help to other beginners, it will have served its purpose. As it is, there was only one actual mistake in the wiring—the omission of a cathode return in the I.F. amplifier. When this was installed, the set played the stations. However, the other points had to be cleared up also before it could be aligned and adjusted.

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PART II—I.F. AMPLIFIERS

This month's instalment introduces the reader to the vitally important subject of television I.F. amplifiers. It explains the need for a bandpass characteristic and the special response curve shapes required by individual systems. The discussion will continue on a more mathematical plane next month.

ENOUGH has already been said in past issues to emphasise the fact that extremely high modulation frequencies are involved in a modern television system. It follows, as a matter of course, that the tuning system of a television receiver, and in particular the I.F. channel, must accept and amplify all the resulting sidebands without undue suppression of those furthest removed from the carrier frequency.

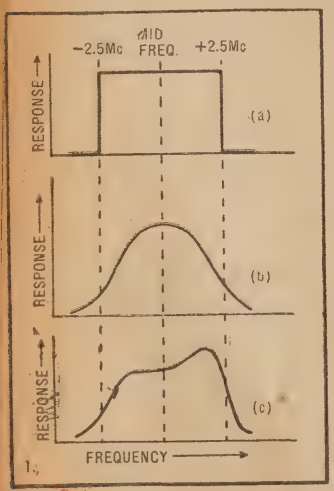


Figure 1. (a) shows the ideal video I.F. response curve for British receivers. Curves (b) and (c) are examples of response more commonly attained in practice.

In sound broadcasting, side-band cutting is well known for its attenuating effect in the treble register. Few designers lose much sleep over the problem, however, because the listening public appear to favor a so-called "mellow" tone.

In a television receiver, side-band cutting tends to reduce detail, and the effect on picture quality is both obvious and unfavorable. If a receiver is, therefore, to stand comparison with other makes on its most obvious characteristic, the IF response curve must be as close to the ideal as it is economically possible to make it.

Depending on transmission standards, the maximum modulation frequency involved may be anything from 3 to 6 Mc., the total bandwidth being double these figures where both sidebands are transmitted. However, single or vestigial sideband transmission is generally used for the higher definition systems, so that most receivers IF channels require in practice an overall bandwidth of about 6 Mc.

In the case of a composite IF channel, the bandwidth must normally be increased by a further small amount to accommodate also the sound signal.

HIGH FREQUENCY

It follows that the intermediate frequency must be considerbaly higher than the band of frequencies it is required to pass, so that traditional figures like 455 and 1900 kc. are automatically ruled out. In point of fact, it becomes necessary to consider the use of an intermediate frequency in a part of the spectrum which, not so long ago, was regarded as quite high even for an RF amplifier.

Apart from exact transmission standards, the choice of a suitable intermediate frequency for the vision signals depends a good deal on the ideas of the designer and upon local conditions. Some of the factors involved in the choice may be tabulated as follows:—

1. It becomes easier to achieve a wide pass band as the ratio of the intermediate frequency to signal bandwith is increased.

2. A high intermediate frequency is likely to give less trouble with oscillator "pulling" and image effects, exactly as in normal broadcast and short-wave practice.

3. Separation of the IF and modulation frequencies at the detector is much simplified if the IF is kept as high as possible.

That is one side of the story. There are other conflicting factors to be considered, however:—

4. If the IF is set too high, ease of manufacture is sacrificed and more specialised test equipment becomes necessary.

5. An excessive IF restricts the choice of valve types and may lead to trouble with instability or inadequate gain.

6. Special rejection circuits, which may be required in the IF channel, are likely to be most effective at a moderate operating frequency.

7. The precise frequency should be chosen to avoid, as far as possible, interference from known radio stations and amateur bands and from images produced by other possible television stations.

While the above statements are very general, they do at least indicate some of the factors which have to be considered.

SEPARATE CHANNELS

In actual practice, English television designers appear to favor intermediate frequencies between 7 and 15 Mc, with a total pass band of from 5 to 6 Mc. By contrast, the majority of American receivers utilise a video IF of about 25 Mc, with a 6Mc, pass band "tailored" to suit the requirements of their vestigial sideband transmissions.

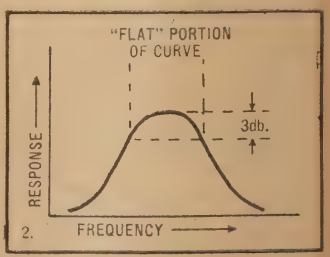


Figure 2. For all practical purposes, I.F. response curves are considered "flat" over portions which lie within 3 db. limits.

To date, most television set designers have preferred to separate the sound and video signals immediately after the mixer valve or an early I.F. stage, running a substantially independent I.F. channel for each. Since a common oscillator is normally employed, the sound I.F. is separated from the video I.F. by the

same amount as the original carrier separation.

This means that the sound I.F. channel may operate at an unusually high frequency, being about 21 or 22 Mc. in most US receivers. A more usual figure for the I.F. channel in an F.M. sound system is 10.7 Mc., and lower still for an A.M. sound channel.

It is, of course, possible to reduce the I.F. of the sound channel immediately to a new and more convenient figure by the use of another oscillator and the double superhet principle. While this has been done in a few receivers, experience has shown that extraordinary care has to be taken to keep harmonics from the second oscillator out of the video channel. The double superhet principle has not been widely favored for this reason.

A further point is that a reduction to too low a frequency for the sound I.F. channel renders the tuning very sharp and underlines any tendency for the receiver to drift during operation.

In other respects, the I.F. channel for the sound section of the set follows standard practice, irrespective of whether it is A.M. or F.M.

NORMAL DETECTOR

In the first instance, the output is fed to a normal A.M. detector, usually a diode, and thence to a conventional audio amplifier. In the case of an F.M. channel, the designer may provide anything from two to four I.F. stages, possibly one or two limiters and either a discriminator or a ratio detector, according to preference.

As far as Australian conditions are concerned, lack of information makes it difficult to forecast figures relating to the sound channel. However, it will probably employ F.M. and be located alongside the video channel to facilitate aerial and tuning arrangements.

The bandwidth required for the video signals will be at least as wide as called for by American standards, and probably a trifle wider.

Taking these factors into consideration, together with international frequency allocations and local valve types, it seems likely that the same order of intermediate frequency will be employed—about 20 Mc. for the sound channel and 25 or 26 Mc. for the video channel.

So much for that. At this juncture, we can afford to pass over other details of the sound circuits and concentrate on requirements of the video I.F. channel.

The shape of the selectivity curve and its relationship to the nominal intermediate frequency depends on whether single or double sideband transmission is involved.

"FLAT" RESPONSE

The BBC radiates both sidebands and the maximum modulation frequency is nominally 2.5 Mc. Thus, the ideal selectivity curve, from the Englishman's point of view, is the rectangular plot of figure 1. An amplifier having this ideal characteristic would amplify equally the sidebands extending to 2.5 Mc. either side of the I.F. eliminating all frequency components outside this range.

It is extremely difficult in commercial practice to achieve a response even approaching the ideal and most commercial receivers exhibit selectivity curves more akin to figures 1b or 1c, depending on the nature of the I.F channel and the accuracy of adjustment.

Recognising that some compromise is inevitable, it is usual to regard a selectivity curve as "flat" over that portion of the range where the response does not fall more than 3db. below the peak response.

The significance of the "skirt" of the selectivity curve depends a good deal on circumstances. If there are no adjacent transmissions, a wide skirt to the curve may be tolerated, even though a steeper cut-off is desirable always to limit unnecessary random interference.

On the other hand, if the sound channel is placed immediately alongside the video channel, using a common aerial and tuner, the video I.F. amplifier may require a sharp rejection characteristic, at least on one side. This may involve the use of at least one sharply tuned "trap" circuit in the video I.F. channel.

SHAPE OF CURVE

Without laboring the point further, it is obviously desirable to aim at the rectangular characteristic of figure 1a rather than the broad rounded response of figure 1b.

If the story were to end at this juncture, there would be no special reason for concern. Using one of several methods, the designer would simply produce the most favorable selectivity curve and there let the matter rest. This approach is still possible with the medium-definition single-station service provided in England by the BBC, and accounts in part for the availability in England of simple and reliable receivers in the £35 class.

The use of higher standards of definition—and these are clearly desirable—would extend the bandwidth requirements of a conventional transmitter to a prohibitive degree, the position being further aggravated if a number of stations had to be fitted into the available spectrum.

As already mentioned, such considerations have led to the adoption of single or vestigial sideband transmission, where one of the sidebands is completely or partially suppressed. This almost halves the "ether space" required by a television transmitter and allows a high definition service to be provided with much the same bandwidth as required by a low definition system using both sidebands.

Vestigial sideband transmission is used in America and is proposed also for Australian stations.

The use of vestigial sideband transmission sets a different requirement for the receiver selectivity curve.

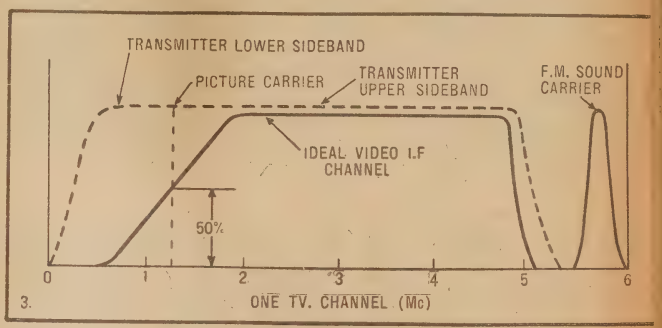


Figure 3. The solid line shows the ideal video I.F. response for US receivers. Note that the I.F. is tuned to one side of the curve, to reduce detector output for low modulating frequencies.

Figure 3 shows the response which is regarded as the ideal for US conditions.

Each channel is 6 Mc. wide and the picture carrier is placed about 1.25 Mc. from the lower limit. It radiates the full range of high frequency sidebands, extending over nearly 4 Mc., but suppresses those lower sideband components, which are displaced more than about 1 Mc. from the carrier frequency. The sound carrier occupies the top half megacycle of the allotted channel.

The dotted line in figure 3 indicates station transmission standards.

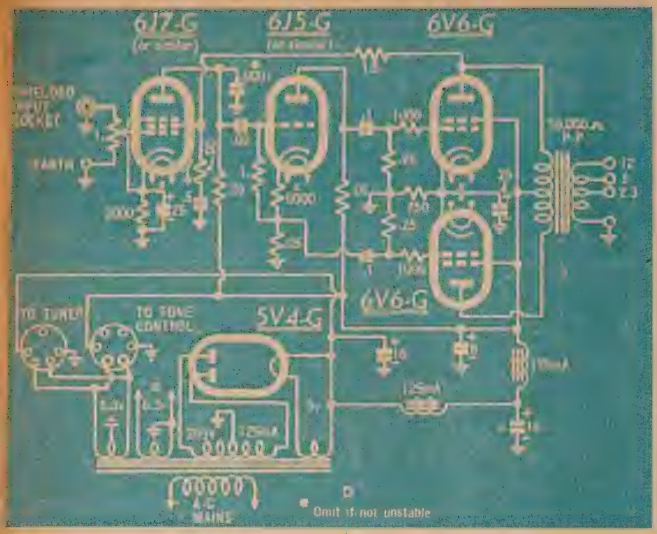
The corresponding and ideal video I.F. response is indicated by the solid line. It is immediately apparent that the receiver must be tuned so that the video intermediate frequency is placed to one side of the I.F. response curve rather than in the centre, as for a double sideband transmission.

CURVE SLOPE

Furthermore, the slope of the curve at the nominal video I.F. is important, for it is relied upon to correct the unbalance created by the vestigial sideband transmission.

In this case, both upper and lower sidebands are present in the transmission for modulating frequencies up to about 1 Mc. For modulating frequencies above about 1 Mc., only the upper sideband is effective. It follows that, if corrective measures were not taken, the video detector would de-

(Continued on Page 99)



The amplifier is similar to the standard 13-watt R & H design. It combines good performance with reliability and cheapness.

MY PERSONAL RECEIVER

Our technical staff turn out, every year, an impressive array of new sets and amplifiers for you to study and build. We investigate and review dozens of new components. But what are our "pet" ideas? What kind of equipment do we use ourselves? This month, our Technical Editor tells you what equipment he uses for radio and records.

SOME years ago, I remember building what was to be, as far as I was concerned, "the set to end sets." Actually, it didn't stay together long, but it left a lasting impression on my mind as an inveterate (and a professional) radio experimenter. The details of the circuit are forgotten, but I do remember that the set had an R.F. and two I.F. stages, two short wave bands, BFO, and two broadcast positions. In one it was a high-performance superhet, in the other, an elementary TRF.

There was push-pull audio, a tone control system and a power supply—all on the one big chassis.

This last feature was its downfall. I soon found out that it was impossible to change the audio amplifier without getting tangled up in the tuner, and so on. I vowed, there and then, that all future sets would be built on the unit principle, so that I could experiment to my heart's content without having to wreck everything in the process.

The standard chassis layout is used for the amplifier, as shown above. The response curves on the right were taken at the transformer secondary.

I've never had occasion to regret this decision.

It also explains the assortment of gear in the domestic set-up. A couple of the units were built years ago, others are quite new. The units have simply been added or changed, as the whim demanded, and the system restored to operation in a couple of hours.

The whole set-up is the product of listening experience in the home rather than theoretical "natterings" in the laboratory.

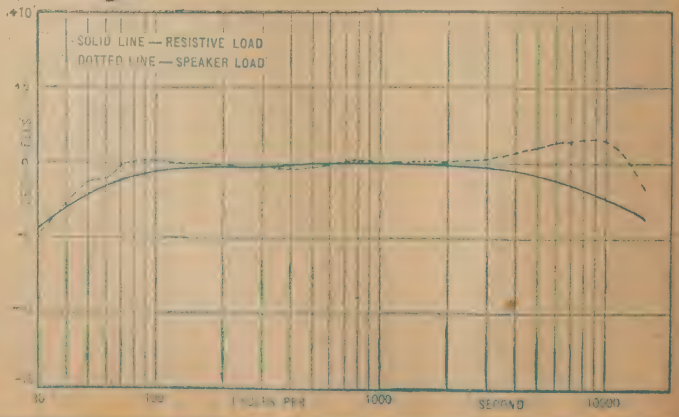
The central piece is a basic amplifier, which was built several years ago. It includes various parts which are now obsolete and the prototype of what has since become a popular line of output transformers.

Theoretically better amplifiers have certainly been designed since, but the marginal difference in performance has not been enough to compel me to put aside more urgent tasks to build a new one.

The circuit is the time-honored arrangement of a pentode voltage amplifier, phase-splitter and push-pull 6V6's with feedback from one plate to the screen of the first pentode. Thousands of similar amplifiers are in service, and the owners may be wondering just how they face up to laboratory instruments.

Measured on resistive load and at the output plates, the frequency response is level over the whole audio range. A check at the transformer secondary, however, reveals some discrepancies, so that the frequency curve is largely a plot of the transformer characteristics.

In my case, I found the amplifier



to be down by just under 4 db at 15 Kc, and by a trifle more at 30 c/s. This on resistive load. When feeding a speaker voice coil, the curve is generally better, due to the changing load impedance at extremes of the range.

The performance at the treble end is thus obviously better than most auxiliary equipment would necessitate, but the bass is a trifle down. In other similar amplifiers, the curve would be better or worse, according to the comparative quality of the output transformer.

WAVEFORM

Viewed on a CRO, there is no trace of distortion at any frequency, while the overload characteristic indicates exact balance between the output valves.

With 275 volts on the high tension line, eight watts are available across the secondary load for an input of 0.4 volt RMS. Gain reduction factor is 4, equivalent to 12 db. of feedback. More power output could be obtained with higher plate volts, but 8 watts is plenty for the home when fed into a sensitive speaker.

The output transformer has tappings for three different voice coil impedances, while there are sockets on the chassis to feed auxiliary units. Since the voltage gain of the basic amplifier is only moderate, it is convenient to have the power supply on the same chassis.

In point of fact, the basic amplifier is a complete and standard unit which can be taken away and operated, if need be, with an ordinary high-output pick-up.

One of these days, I may take steps to correct the rather academic discrepancies which the test revealed. By simply installing one of the special output transformers intended for the Williamson amplifier, it should be possible to remove the droops at 30 c/s and 15kc, as revealed by the curves.

Better still, I may build up a new 807 version of the existing circuit, have a trifle more feedback, and use the Williamson type transformer. An amplifier along such lines should be quite as good as the Williamson for all practical purposes and be free from some of its critical characteristics.

While I like the idea of a flat basic amplifier, I am also in favor of using a tone control system which permits independent adjustment of the bass and treble response. It is entirely fallacious to assume that the signals fed to the amplifier are themselves "flat" or even consistent!

The unit which I connect ahead of the amplifier for this purpose is more than just a tone conpensating stage. It is a complete control head and mounts up underneath the motor board with the knobs readily accessible. A full description appeared in the March, 1949 issue.

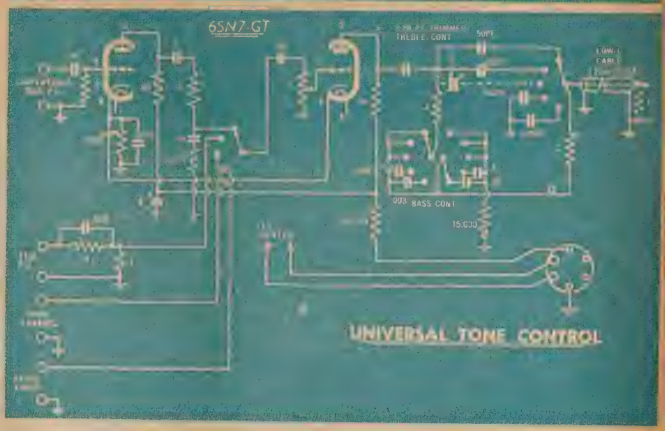
The unit has a selector switch and four sets of input terminals. The first position connects to a pair of terminals for a lightweight magnetic pickup and a triode amplifier which provides full bass compensation and a small margin of gain. I can feed almost any lightweight pickup into these terminals and know that it is fully compensated.

The gain is sufficient to give good room volume from all but the lowest output types.

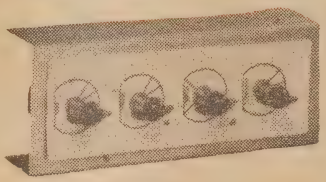
The second position bypasses the compensating triode, but includes a simple R/C network intended for a crystal cartridge. The other two switch positions run straight to the appropriate terminals, and are used for radio tuners or any other input device in which I may be interested. By this means, I have run some very interesting AM versus FM tests, switching instantaneously from one tuner to the other.

by W. N. Williams

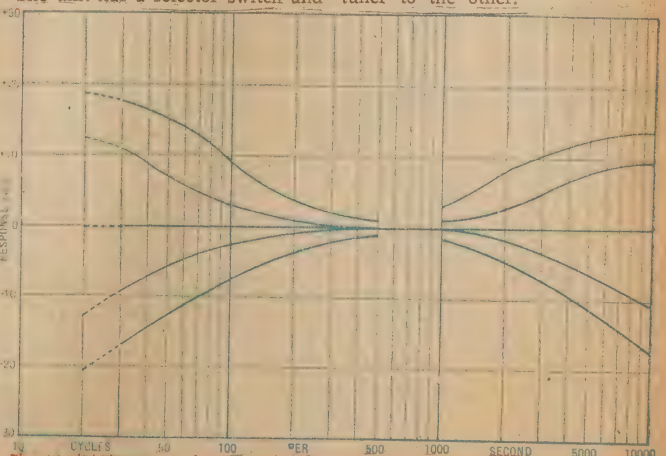
THE TONE CONTROL SYSTEM



Here is the control unit for the amplifier—bass, treble, volume and channel selection. It has built-in compensation for lightweight pickups.



The control unit is built in an aluminium channel and provided with a removeable cover for complete shielding. It fits up under the motor board.



The tonal balance can be "doctored" in a variety of ways to compensate variations in programme material, listening level and so on. It can be applied quite independently of the low-pass filter in the voice coil circuit.

Homecrafts PTY. LTD.

LARGEST STOCKS GREATEST BARGAINS

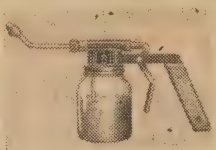
HOMECRAFTS BATTERY CHARGER KIT. Kit of parts to build a 6 volt, 4 amp. Battery charger. Kit includes an English Selenium Rectifier, Transformer, Black Crackle Finish Metal Case, 2 Terminals, Hook-up Wire and Circuit Blue Print Instruction. Price, £4/10/-.
12 volt 5/- extra.

CHASSIS HOLE CUTTERS. Adjustable Chassis Hole Cutters. Cuts holes from 1 inch to 3½". Price, 16/7.

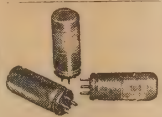
CHOKES. Pye Wound R.F. Chokes. As illustrated. 2/11 each.

BARGAIN RADIO KNOBS. Large sized radio knobs, 5d each.

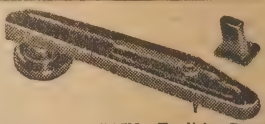
B.R.S. RECORDING BLANKS. High grade recording discs with highest quality aluminium base. Available in three sizes, as illustrated. 8", 5/2. 10" 6/6, and 12", 8/6.



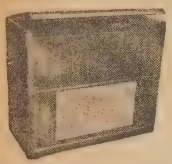
THE NEW "ZEPHER" HAND SPRAYER. The new "Zepher" Hand Sprayer has hundreds of uses. As illustrated, small size, 24/6; large size, 26/6.



VIBRATORS. 12 Volt Non-Synchronous Vibrators, standard type. Usually 30/-, cut to only 9/11.

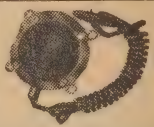


PICKUP BARGAIN. English Cosmocord Brand new streamlined crystal pickups. As illustrated. Reduced from £3/7/9 to 32/11.

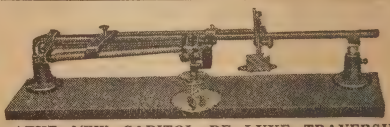


RADIO CABINETS. Beautiful walnut piano finish standard model. £13/19/6. Model with deep well for record changer. £14/7/-. Also available in blonde finish. Standard model. £16/9/6. Model with deep well for record changer. £16/17/-. Country and interstate clients add 15/- packing charge.

JUMBO TYPE VALVE SOCKETS. Suitable for 211E, etc. As illustrated. 28/6 each.



AGAIN AVAILABLE. English D104 High Fidelity Crystal Microphones. As illustrated. Only £4/19/6.



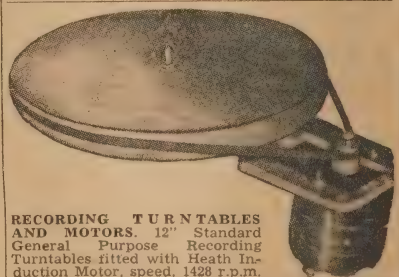
THE NEW CAPITOL DE LUXE TRAVERSING GEAR. Overhead traversing gear for recording from 8" to 16" discs. Precision engineered. As illustrated. **Price, 11 Gns.**

Country and interstate clients please add freight or postage.

CAR RADIO KIT. Radio and Hobbies Car Radio Kit. As described in May issue of "Radio and Hobbies." Homecrafts special concession offer of this kit complete to the last nut and bolt, only 18 Gns, as illustrated.

DISCOL HARDENING COMPOUND. For prolonging the life of Recordings. Complete with instructions for application. 4oz. bots., 2/9. 8oz. bots., 5/6.

SCOPE SOLDERING IRONS Ready for use in six seconds. Operates on 6-volt battery or from mains. Price, 43/6. Transformer for mains operation, 36/-.

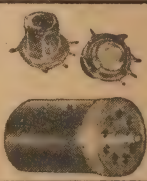


RECORDING TURNTABLES AND MOTORS. 12" Standard General Purpose Recording Turntables fitted with Heath Induction Motor, speed, 1428 r.p.m. 40 watt. Complete with two-speed pulley direct driving turn-table. Price, 16 Gns,. complete. Suitable for use with Capitol Traversing Gear

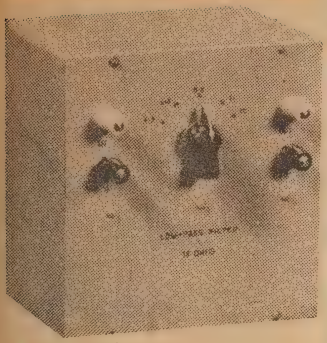
MECHANOID CUTTING HEAD. A low priced Cutting Head (500 ohm. Impedance) with outstanding performance. Suitable for use with Capitol Traversing Gear. Price, as illustrated, £5/10/-.

DISPOSAL VALVE BARGAINS—AVAILABLE FOR IMMEDIATE DELIVERY.

Type EF50. High gain RF Pentode. 6.3v. 9-pin lockin socket 16/-
Type EA50. 6.3v. VHF Diode, suitable for Vacuum Tube Voltmeter Test Probes . . 16/-
Type 954. 6.3v. Det Amp. Pentode Acorn Base. As illustrated 16/-
Type 955. 6.3v. Det. Amp. Osc. Acorn Base. As illustrated 16/-
Type 7A6 Twin Diode 16/-
Type 807 Beam Power Amplifier 16/6
Type 42 SPT 4 volt Cossor screened pentode 14/-
Type 5BP1 6.3v. Cathode Ray; 5in. Screw Elect. Deflection . . . . . 37/6 plus Sales Tax
Type 7C7 Triple Grid 6.3v. 8-pin lockin . . 16/-
Type 2 x 2 High Vacuum Rectifier 4 pin . . 16/6
Type 834 7.5v. 4 pin power amplifier 30/3
Type 6SH7 Sharp Cut Off RF Pentode 16/-
Type 211 10v. X Jumbo, 4 pin Power Triode 28/3
Type 830B 10v. Triode 60 Watt 25/-
All prices include excise.



290 LONSDALE STREET, MELBOURNE,. CENTRAL. 4311



The voice coil top-cut filter unit and, on the right, the circuit diagram. Response curves for the unit were published in the January 1950 issue.

The system could obviously be extended to accept as many input channels as there are points on the rotary switch.

The spare channel is used occasionally with one or other of the old-style pickups for purposes of reference or comparison. For normal playings I have been using a Goldring "Headmaster," but without the transformer and equaliser. The pickup output is fed straight into the "lightweight pickup" terminals in parallel with a 0.1 meg. load resistor.

I prefer on principle, to rely on a valve and resistive circuits to provide gain and bass correction rather than on a transformer. The pickup will not drive the amplifier to overload, except on heavy recordings, but there is always plenty of output for the living-room. Extra gain could have been provided if it had proved necessary in practice.

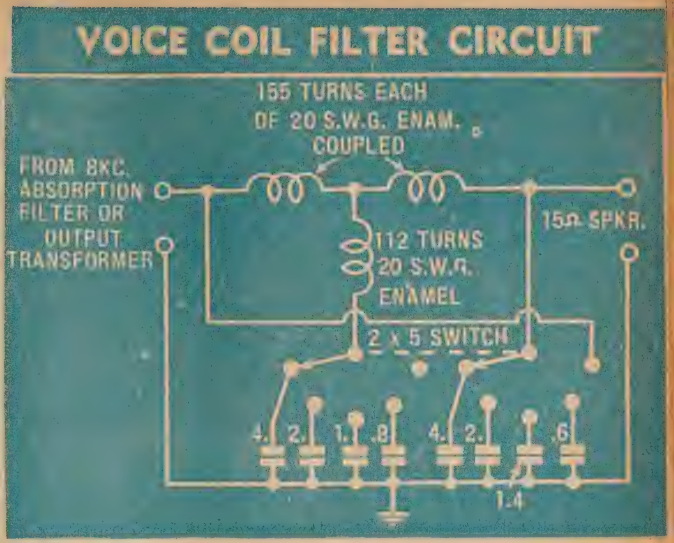
The output from the control unit is fed to the amplifier via a length of low capacitance cable, terminating in a shielded plug. This was found necessary to avoid hum pickup and undesirable treble losses which ordinary shielded wire would have introduced.

VOLUME CONTROL

The volume control of the main amplifier is normally left full-on, avoiding further treble loss from having the control in an intermediate position.

The decoupling network provides adequate filtering while the isolation of the unit gets away from eddy current hum. It is a good idea, however, to run the B-minus or earth return wire from the power socket in the amplifier back to the earthing point for the signal input plug. If this is not done, eddy current voltages may be introduced between the earth points and appear at the input grid as 50-cycle hum.

I was very happy with this general set-up until I began to chase the extreme treble response, or should one say the frequencies over about 6kc. Appreciating the lack of effective tweeters, I invested in a Goodman's



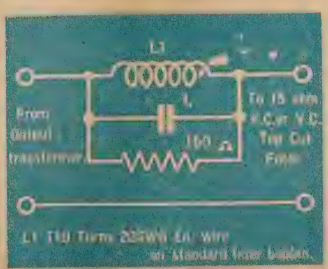
Axiom 12. This was shown to have a response better than my ears, which cut off abruptly at 15½kc.

DISTORTION

The installation of this speaker quickly revealed distortion in many records and programmes which was only vaguely apparent with the more modest reproducer. Some discs were good, others were bad. Some played well at the outside and became atrocious towards the centre. I found myself in the unpleasant situation of wanting to hear the "highs" but with more than half the records unplayable.

The immediate tendency was to blame the speaker for everything, but this could obviously not be the case, because some discs and studio programmes were above reproach.

The 8 Kc absorption filter is shown above. It is screwed to the baffle, just near the speaker. Circuit below is very simple.



Clearly, the extended treble response was showing up high order distortion effects which had hitherto been unimportant.

Tests showed that the existing tone control unit could not suppress the treble sufficiently, when required, and attention turned to selective top-cut filters. This much of the story has already been told in the December and January last.

With a 15 ohm speaker, the voice coil filter is obviously the more convenient one and this was finally installed as a permanent part of the set.

The unit is screwed to the floor of the cabinet and the spindle extended (with 9d worth of brass rod) allowing the switch to be operated by a panel knob. The shaft lines up with those on the control head already mentioned and the knobs are identified by a card, as illustrated on the next page. A photographer friend produced a reversed sepia print from "paste-up" art work, which matches the color of the motor board.

Non-technical members of the family are content to leave the frequency control knobs in the centre position which, happily enough, gives a level overall response and a treble cut-off at 8.5kc.

The electrical circuit presents no difficulties and is more or less self-explanatory. An unfortunate error which occurred in the original issue has been corrected. The coils are wound on bobbins having 2in diameter cheeks and a centre wooden core of 1in diameter and ¼in long. One coil is quite separate, the other two being wound side by side and separated by a single common cheek, 1/8th inch thick.

8KC. PEAK

While investigating the characteristics of the Axiom 12, a peak was noted at about 8kc. which we considered might selectively emphasise high order distortion com-

STANDARD -FERGUSON- RANGE

POWER & VIBRATOR TRANSFORMERS

	A.C.	Vib.					Retail
PF 122	240	6	220	40	6.3V @ 2A		33/6
PF 125	240	6	250	60	6.3V @ 2A		43/-
PF 119	240	6	325	125	6.3V @ 4A		62/-
PF 182	240	12	200	40	12.6V CT @ 1A		33/6
PF 126	240	12	250	60	12.6V CT @ 1A		47/6
PF 146	200,30,40	12	325	150	12.6V CT @ 2.5A		67/-

FILTER CHOKES

	Induct	D.C. Res.	M.A.		Retail
CF 100	50	1900	10		18/-
CF 101	30	870	25		18/-
CF 102	15	300	60		12/-
CF 103	30	420	60		26/-
CF 104	30	580	75		31/-
CF 105	15	250	80		24/-
CF 106	12	200	100		24/8
CF 107	30	360	100		34/8
CF 108	12	135	150		35/-
CF 109	20	225	150		37/8
CF 110	12	100	200		43/8
CF 111	16	165	200		45/10
CF 112	10	70	250		46/2

SPECIAL CHOKES

					Retail
CF 113	.5	70	250		
	20		50	Swinging choke	50/6
CF 114	1.1	23	375	Ballast choke	24/-
CF 115	.017	.6	2 amps	L.T. choke	10/-

OUTPUT TRANSFORMER TO VOICE COIL
Full Frequency Range (30-15000)

Code No.	Pri. Imped.	Sec. Imped.	Watts	Retail
OP24	5000 SE	8.4, 2.1, with feed back	5	44/10
OP23	3250 SE	12.5, 8.4, 2.1	10	65/1
OP19A	5000 PP	12.5, 8.4, 2.3	15	102/10
OP51	4500 PP	15.5, 12.5, 8.6, 2.8, 2	20	36/9
OP63	10000 PP	15, 3.75	15	100/-
OP64	10000 PP	12.5, 3.125	15	100/-
OP65	10000 PP	8.4, 2.1	15	100/-

OUTPUT TRANSFORMER TO VOICE COIL
Special Full Frequency (20-30,000)

					Retail
OP25/40	10000 PP	40, 10	15		130/-
OP25/16	10000 PP	16, 4	15		130/-
OP25/15	10000 PP	15, 3.75	15		130/-
OP25/12	10000 PP	12, 3	15		130/-
OP25/10	10000 PP	10, 2.5	15		130/-
OP25/8.4	10000 PP	8.4, 2.1	15		130/-
OP66	5000 PP	8.4, 3.7	15		130/-
OP67	5000 PP	15, 6.5	15		130/-

OUTPUT TRANSFORMER TO LINE—
Full Freq. Range.

					Retail
OP22	3250 SE	500, 125, 8.3	10		65/1
OP19b	5000 PP	500, 250, 125	15		102/10
OP21	8000 PP	500, 250, 125	15		82/10
OP62	10000 PP	500, 125	15		100/-

OUTPUT TRANSFORMER TO LINE—
Special Full Freq. Range

					Retail
OP25/500	10000 PP	500, 125	15		130/-
OP25/250	10000 PP	250, 62.5	15		130/-

VIBRATOR TRANSFORMERS

Code No.	Pri. V.	D.C. Out.	MA	Buffer Full Sec.		Retail
VT 100	32	200	40	.005	Sync.	27/-
VT 101	6	90	15	.008	"	19/6
VT 102	6	150	25	.005	"	23/10
VT 103	6	200	50	.005	"	25/-
VT 104	6	250	60	.005	"	37/-
VT 105	12	250	60	.005	"	37/-
VT 106	6	300	75	.008	"	52/-
VT 107	6	250	60	.005	Sync. Low Rad.	30/6
VT 108	12	90	15	.008	Sync.	21/8
VT 109	24	90	15	.008	"	23/8
VT 110	12	150	25	.005	"	23/10
VT 111	24	150	25	.005	"	26/6
VT 112	12	200	50	.005	"	25/-
VT 113	24	200	50	.005	"	26/6
VT 114	12	300	75	.008	"	54/2
VT 115	24	300	75	.008	"	55/6
VT 116	24	250	60	.005	"	30/-
VT 117	12	250	60	.005	Non Sync. Low Rad.	31/-
VT 119	32	150	25	.005	Sync.	25/6
VT 121	6	180	30	.005	"	25/4
VT 122	6	400	50	.005	"	50/-
VT 123	12	320	125	.005	Sync.	63/3
VT 124	32	250	60	.005	"	30/-
VT 127	6	200	50	.005	Sync. Low Rad.	29/8
VT 128	12	250	60	.005	Sync. Low Rad.	38/-

RECEIVER POWER TRANSFORMERS

Code No.	Prim.	HTV Aside	M.A.	Filaments	Retail
PF 185	240	150	50	6.3V @ 2A	24/-
PF 106	240	325	45	6.3V @ 2A, 5V @ 2A	30/-
PF 198	240	285	50	6.3V @ 2A, 5V @ 2A	30/-
PF 151	200,30,40	285	60	6.3V @ 2A, 5V @ 2A	34/-
PF 165	200,30,40	385	60	6.3V @ 2A, 5V @ 2A	34/-
PF 170	200,30,40	285	80	6.3V @ 2A, 6.3V @ 2A, 5V @ 2A	39/10
PF 168	200,30,40	385	80	6.3V @ 2A, 6.3V @ 2A, 5V @ 2A	39/10
PF 130	200,30,40	285	100	6.3CT @ 2A, 6.3V @ 2A, 5V @ 2A	46/-
PF 160	200,20,40	385	100	6.3CT @ 2.5A, 6.3V @ 2A, 5V @ 2A	46/-
PF 152	200,30,40	285	125	6.3CT @ 3A, 6.3V @ 2A, 5V @ 2A	56/-
PF 181	200,30,40	385	125	6.3CT @ 3A, 6.3V @ 3A, 5V @ 2A	66/-
PF 174	200,30,40	285	150	6.3CT @ 2A, 6.3V @ 2A, 5V @ 2A	60/-
PF 175	200,30,40	385	150	6.3CT @ 2A, 6.3V @ 2A, 5V @ 3A	70/-
PF 173	200,30,40	425	175	6.3CT @ 3A, 6.3V @ 2A, 5V @ 3A	110/-
PF 140	200,30,40	385	200	6.3CT @ 3A, 6.3V @ 3A, 5V @ 3A	111/-
PF 171	200,30,40	385	250	6.3CT @ 4A, 6.3 @ 3A, 5V @ 3A	144/-

LINE TO VOICE COIL TRANSFORMERS

	Pri. Imped.	Sec. Imped.	Watts	Retail
MT111	500	12.5, 8, 2.3	10	36/9
MT100	600	4, 3	15	36/9
MT101	500	15	15	36/9
MT124	600, 500	4, 3, 2.7, 2.3, 2	25	66/-
MT125	600, 500	15, 12.5, 8.4, 6.5	25	66/-

MODULATION TRANSFORMERS

				Retail
MT118	8000, 6000 PP	10000, 7000, 5000	25	85/-
MT119	8000, 6600, 3800 PP	1000, 7500, 6500, 5500, 4500, 3500.	50	111/-
MT120	500 to 20000 in steps.	500 to 30000 in steps.	50	200/-
MT121	500 to 20000 in steps.	500 to 30000 in steps.	125	276/-

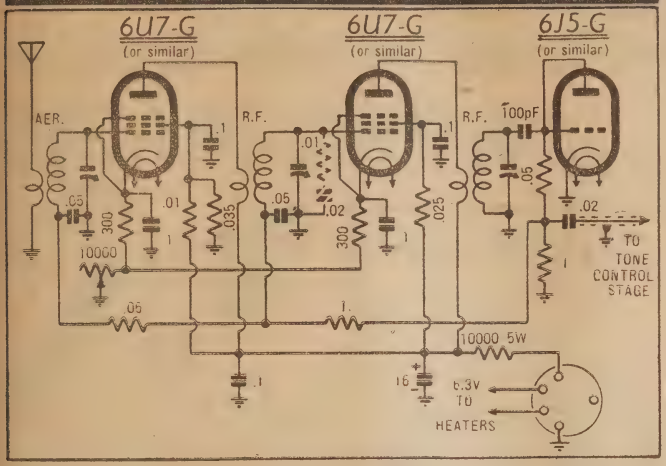
Output Transformer To Voice Coil—P.A. Range

	Pri. Imped.	Sec. Imped.	Watts	Retail
OP1	5000, 2500 SE	12.5, 8, 2.3	10	39/10
OP54	5000, 2500 SE	15, 12.5, 8.4, 6.5, 4, 3, 2.7, 2.3, 2	10	45/8
OP39	5000, 2500 SE	15	10	39/10
OP33	5000, 2500 SE	5, 2.7	10	39/10
OP41	5500 SE	3.7	10	46/-
OP53	30000, 20000 14000, 10000, 7000 5000, 2500 PP	2.3	10	36/9
OP2	5000 PP	12.5, 8, 2.3	15	65/1
OP55	5000 PP	15, 12.5, 8.4, 6.5, 4, 3, 2.7, 2.3, 2	15	73/10
OP3	6600 PP	12.5, 8, 2.3	15	65/1
OP56	6600 PP	15, 12.5, 8.4, 6.5, 4, 3, 2.7, 2.3, 2	15	73/10
OP4	10000 PP	12.5, 8, 2.3	15	65/1
OP57	10000 PP	15, 12.5, 8.4, 6.5, 4, 3, 2.7, 2.3, 2	15	73/10
OP5	10000, 6600, 5000 PP	12.5, 8, 2.3	15	65/1
OP58	10000, 6600, 5000 PP	15, 12.5, 8.4, 6.5, 4, 3, 2.7, 2.3, 2	15	76/2
OP59	10000, 6600, 5000 PP	15, 12.5, 8.4, 6.5, 4, 3, 2.7, 2.3, 2	25	93/8
OP60	10000, 6600, 5000 PP	15, 12.5, 8.4, 6.5, 4, 3, 2.7, 2.3, 2	32	116/8

OUTPUT TRANFORMER TO LINE—P.A. Range

	Pri. Imped.	Sec. Imped.	Watts	Retail
OP1A	5000, 2500 SE	500	10	39/10
OP44	5000, 2500 PP	500, 250, 125	10	47/-
OP34	5000 PP	600, 300, 200, 150, 130, 100, 75, 50	15	81/4
OP6	5000 PP	500, 250, 125.	15	65/1
OP7	6600 PP	500, 250, 125	15	65/1
OP50	8000 PP	600, 300, 120, 60, 30	15	126/-
OP8	10000 PP	500, 250, 125	15	65/1
OP8M	10000 PP	500, 250, 160, 125, 100, 83.5, 71.5, 62.5, 55.5, 50	15	71/3
OP9	10000, 6600, 5000 PP	500, 250, 125	15	65/1
OP10	5000 PP	500, 250, 125	25	81/10
OP11	6600 PP	500, 250, 125	25	81/10
OP38	6600 PP	600, 300, 250, 200, 170, 150, 76, 50, 36, 27, 12.5, 7.5, 3.6.	25	140/-
OP12	10000 PP	2.7	25	81/10
OP13	10000, 6600, 5000 PP	500, 250, 125	25	81/10
OP35	10000, 6600 PP	500, 4000, 8.4, 2.2	25	120/-
OP14	5000 PP	500, 250, 125.	32	102/10
OP48	6600 PP	140, 70.	32	117/8
OP15	6600 PP	500, 250, 125	32	102/10
OP15M	6600 PP	500, 250, 166, 125, 100 83.5, 71.5, 62.5, 55.5, 50	32	104/1
OP16	10000 PP	500, 250, 125	32	102/10
OP17	10000, 6600, 5000 PP	500, 250, 125	32	102/10
OP36	3800 PP	17.6	60	108/7
OP18	3800 PP	500, 250, 125	60	108/7
OP61	3800 PP	100, 75, 25, 10, 5, 3	60	133/8
OP37	6400 PP	500, 250, 125	80	150/8
OP49	8800, 6000 PP	500	105	210/-
OP20	11600, 8400 PP	500, 250, 125	150	276/-

TUNER IS SIMPLE, EFFECTIVE

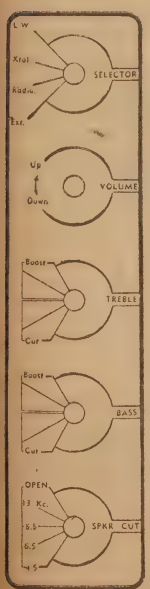


The tuner is an elementary affair. Centre coil is loaded down to minimum required gain and sensitivity. A triode serves as detector, connected as a diode, but a 6H6 would work equally well.

ponents as well as needle scratch. An additional, highly-damped absorption filter was duly made up to put a shallow dip in the response in this region. The filter coil is wound on the same type of bobbin as already described.

The immediate effect of inserting the filter was to even out the remaining scratch to a silky hiss and to reduce considerably the tendency for the reproduction to show "rattle" effects on poor discs.

I am now very happy with the speaker circuit, even though I know there is a discrepancy between the 12 ohm transformer winding and the 15 ohm speaker voice coil. I'll correct that, one of these days, and set my mind at rest. My ears won't notice the difference!

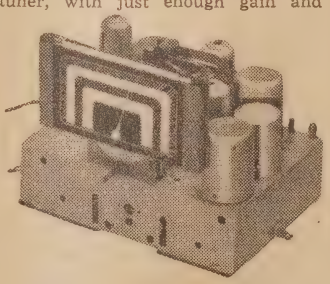


A card clearly defines the function of all amplifier controls. With too many knobs, even the constructor can forget their purpose.

The final item is the radio tuner, which is essentially a very simple affair.

Analysing the family listening habits, I was forced to admit that we never tuned to anything but a local broadcast station. Furthermore, when I did want to listen to short-wave the best place to do it was in my own "den," where the whistles and crackles could not disturb other members of the household.

Having admitted this much, the obvious choice became a simple TRF tuner, with just enough gain and selectivity to bring in the locals and only one knob to turn the dial.



The tuner has only one control—the tuning knob.

I have forgotten where the coils and gang came from but they were an old solenoid kit with a pre-selector stage. I reckoned that the pre-selector would be a good thing, just in case we did want to listen to an interstate station! What a difficult thing is human nature.

The completed tuner worked very well but I had to admit that the selectivity wasn't very much down on an ordinary superhet. The high frequency "Bug" soon cured that. First of all the pre-selector stage was cut out, then I began loading the centre tuned circuit until the tuning broadened out noticeably.

The loading resistor ultimately finished up at 10,000 ohms, being wired across the top of the gang in series with a .02 condenser. This latter component was included

(Continued on Page 96)

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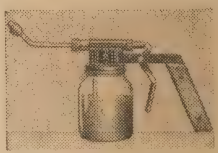

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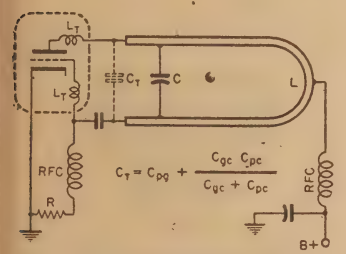
VALVES AND CIRCUITS FOR UHF

This excellent summary of valve or "tube" requirements for UHF work comes from the Aerovox Company of USA. All the factors discussed here have a direct bearing on circuitry which, via Television and UHF communication generally, will eventually be as familiar to us as those now used for short wave and medium band broadcasting.

IN the past, commercial use of the ultra-high frequency portion of the radio spectrum (300-3000 Mc) has been somewhat limited. Now, with the recent allocation of the 475-890 Mc band for UHF television, and the inauguration of the Citizens Radio Service in the frequencies between 460 and 470 Mc, it is certain that this region will become increasingly active.



TYPICAL UHF OSCILLATOR CIRCUIT
FIG. 1

Since the tubes and circuitry employed at such frequencies are unique, it should be valuable to review them at this time. This study will be confined to triode tubes of the conventional negative-grid type which are most likely to be utilised in receiving circuits for UHF television, Citizens Radio, and UHF amateur communication.

SPECIAL TUBES

In UHF receivers of the superheterodyne type, it is usual that only the "front-end" tubes, ie, the rf amplifier, mixer, and local oscillator, are of special high frequency design. The other tubes and circuits beyond the mixer are usually of the low frequency variety. Similarly, in the superregenerative receiver only the detector and rf stage (if used) function at the carrier frequency. Actually, above 500 megacycles there are very few effective rf amplifiers available in the low cost field, and the function of mixing, or frequency conversion, is being widely assumed by the silicon crystal diode, since in this range it exhibits better noise performance than the vacuum tube as a mixer. Therefore, at the present time, tubes for local oscillator or superregenerative detector service are of primary interest as being the remaining tubes which must operate near the frequency of the UHF signal to be received in most designs.

LIMITING FACTORS

Receiving tubes of conventional design are not capable of satisfactory performance at ultra-high frequency because of several limitations which are inherent in their construction.

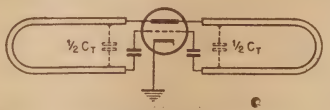
Chief among these limiting factors are excessive interelectrode capacitance and inductance. That these quantities set a definite upper limit on the frequency of operation of a given vacuum tube design may be seen by considering the typical UHF oscillator circuit of Fig. 1.

In this circuit the frequency of oscillation is determined by the values of resonant circuit inductance (L) and capacitance (C) as related by Thomson's formula:

$$(1) \qquad f = \frac{1000}{2\pi\sqrt{LC}}$$

Where: f is the frequency of oscillation in megacycles.
L is the circuit inductance in microhenries.
C is the circuit capacitance in micromicrofarads.

From this equation it is seen that the frequency of the resonant circuit varies inversely as the square root of the product LC. For operation at frequencies above 300 megacycles, this product must be less than .28.



R.F. CIRCUIT
OF DOUBLE-ENDED OSCILLATOR
FIG. 2

However, as shown in Fig. 1, the inductance of the leads within the tube and the capacitance between the electrodes must be added to those of the external circuit. Thus, if an attempt is made to use a conventional receiving tube (such as a 6J5) at such frequencies, it will be found that the product of the capacitance of several micromicrofarads contributed by the tube and the inductance of the small wire leads which connect the elements to the base pins would be considerably greater than .28, even with the external circuit reduced to a direct connection between the grid and plate.

Operation under this condition is sometimes called the "self-resonance" of the tube in manufacturers data sheets, but does not represent a practical operating point, since the efficiency of such a circuit would be very low, coupling would be difficult, and tuning nearly impossible.

Another factor which prevents the efficient operation of common receiving tubes at the ultra-high frequencies is "transit time," or time required for an electron emitted from the cathode of the tube to reach the anode.

For practical operation, this "time of flight" must be a small fraction of the period of one rf cycle—usually less than one-tenth. If it is appreciably longer, the output of the tube becomes small. This decrease in efficiency results from the fact that long transit time prevents the electrons from remaining in the proper phase to deliver maximum energy to the oscillating circuit.

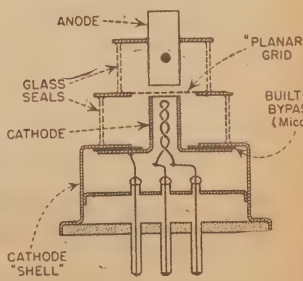
In other words, with excessive transit time, the rf field between the tube electrodes may reverse while electrons are traversing these spaces, so that the electrons absorb energy rather than deliver it.

CIRCUIT LOSSES

Excessive circuit losses also limit the use of standard receiving tubes to the lower frequencies. Such losses may take several forms, including:

(a) **"Skin-effect" losses.** Since ultra-high frequency currents flow mainly on the surface of metallic conductors, the resistance of the small wire leads usually used in tubes is very much greater at these frequencies than at lower frequency.

(b) **Circuit radiation losses.** At UHF wavelengths, even a short length of wire may radiate consider-



SHOWING CONSTRUCTION
OF "LIGHTHOUSE" TRIODE
FIG. 3

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able energy. Tube leads, unless spaced close to others carrying out-of-phase currents, will cause rf radiation losses which reduce efficiency and output.

(c) **Dielectric losses.** The standard bakelite bases and glass "presses" used in most receiving tubes are too lossy for use at UHF. Such poor dielectrics, especially if they occur where electrostatic fields are strong, absorb rf energy which is converted to heat. The process is cumulative, since the dielectric losses increase with temperature.

The combined result of the foregoing effects is to cause the efficiency and power output of conventional receiving tubes to drop to impractical values at frequency limits below 100 Mc for most designs. Even many tubes in the miniature and sub-miniature classes are limited to frequencies below 300 Mc by these same effects, unless special precautions have been taken in their design.

SPECIAL DESIGNS

Table 1 lists some of the readily available tubes which are effective in at least the lower portion of the UHF band currently of interest. In these tubes, the limitations discussed above have been reduced by special design features. We will now discuss these features.

Transit time may be reduced in a vacuum tube by decreasing the spacing between the elements or increasing the plate voltage so that the electrons move faster. The former is the best approach in receiving tubes, however, since plate voltage must be **quadrupled** to **double** the velocity of the electrons. Thus, rather high voltages would be required to achieve UHF operation.

It is usually more convenient to reduce the electrode spacing. This, of course, has mechanical limitations, since the grid-to-plate spacing must not be too small, if the tube is to have a sufficiently high amplification factor (mu). In most UHF triodes, the grid-cathode spacing is

TABLE I

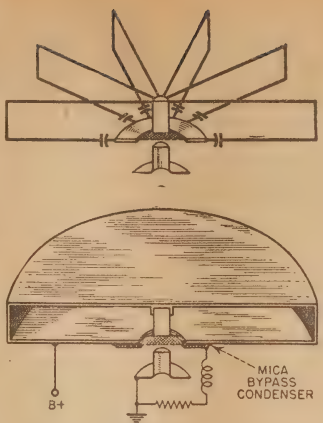
TYPE	MAX. FREQ. MC.	DESIGN
958A	500	Acorn (Single-ended)
6N4	500	Miniature
955	700	Acorn (Single-ended)
316A	700	Door-knob (Single-ended)
6F4	1200	Acorn (Double-ended)
368A	1700	Door-knob (Double-ended)
2C40	3000+	Lighthouse

only a few thousandths of an inch for these reasons, and is less than .001 inch for one special triode tube.

It will be readily seen that the reduction of element spacings in the vacuum tube to reduce electron transit time has an adverse effect upon the inter-electrode capacitance. As the elements are moved closer together, the capacitances between them increase proportionately. This, of course, reduces the maximum frequency of operation as shown by Eq. 1.

The only recourse which the tube designer has in this case is to reduce the area of the tube electrodes to keep the tube capacitances within useable limits. This necessity, in turn, limits the power handling capabilities of the tube by reducing the anode heat dissipation and cathode area. Such considerations explain why the generation of radio frequency power becomes increasingly difficult as the operating frequency is raised.

Tubes of the "acorn" type (955) and the "door-knob" type (316A) represent about the best that can be done by the simple expedient of reducing tube dimensions to minimise transit time, lead inductance, inter-electrode capacitance and dielectric losses. Some such tubes function up to about 700 megacycles as oscillators. Beyond this frequency limit, tubes which are adaptable to special circuits must be used.



DEVELOPMENT OF "LIGHTHOUSE" TUBE CAVITY OSCILLATOR FROM "MULTIPLE-ENDED" CIRCUIT

FIG. 4

DOUBLE ENDED CIRCUITS

A considerable increase in the upper frequency limit is achieved by the "double-ended" circuit shown in Fig. 2. In this arrangement, the tube is provided with dual grid and plate leads and a separate resonant circuit is connected to each pair of leads. The tube capacitance is now part of two resonant circuits and may be thought of as being shared between them. Therefore, each resonant circuit has only half of the effective capacitance value that the same tube would add in the circuit of Fig. 1.

For this reason, the size of each of the inductances in Fig. 2 would be considerably larger for operation at the same frequency, or would permit operation at considerably higher frequency before becoming impractically small. Another way of considering this extension of frequency limit is by noting that the two inductances are now in parallel, which reduces the effective value which resonates with the tube capacitance to approximately one-half.

This lower value of inductance, when substituted in Eq. 1, gives a much higher frequency. Another advantage to the use of the double-ended circuit results from the fact that the oscillating rf currents divide equally between the two circuits so that skin-effect losses are considerably smaller.

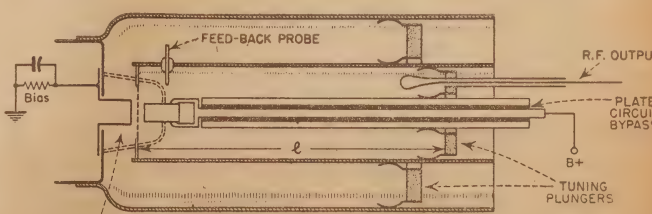
The 6F4 and the 368A are examples of tubes having double-ended construction. The 6F4 is a triode of the "acorn" type with dual grid and plate leads which is especially well adapted to local oscillator service in the UHF television band. It has an upper frequency limit of about 1200 Mc. The 368A is a larger tube of the "door-knob" type, operable to 1700 megacycles.

LIGHTHOUSE TUBES

During World War II, a substantial advance in the high frequency performance of conventional triode tubes was made by the introduction of the planar-grid "lighthouse" tube. The general construction of this tube family is illustrated in Fig. 3. Tubes of this type, such as the 2C 40, serve as grounded-grid amplifiers and oscillators at frequencies exceeding 3000 megacycles.

The improved performance of the lighthouse tube is due to the novel construction employed. The use of "disc-seals" and planar (or flat) cathode, grid, and plate elements permits the factors which usually limit triodes to be reduced to a minimum.

This feature was made possible by the development of special metal-to-glass sealing techniques. Lead inductance is extremely low because wire leads connecting the tube electrodes to the external circuit have been replaced by flat metal discs which extend radially from the tube elements through the glass seal. Inter-electrode capacitances are very low because the effective heat dissipation of the disc-seals makes the use of small plate and grid areas practical.



COAXIAL CAVITY OSCILLATOR

FIG. 5

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A good example of the increase in electrode cooling by thermal conduction through the disc-seals is readily seen in the comparison of the rated maximum plate dissipation of the radiation cooled 955 and the conduction cooled 2C40. Although the 955 has a larger active plate area, it is rated at only 1.6 watts dissipation, whereas the 2C40 plate will dissipate over 6.5 watts because of heat conduction through the seal to the external circuit.

Losses due to "skin-effect" are also minimised in the lighthouse type of construction since the surfaces connecting the tube electrodes to the external circuit are large and are silver plated, for better rf current conduction.

The lighthouse tube, or so-called megatron, was especially designed for use in coaxial or cavity circuits. It may be used in lumped-constant and parallel-line circuits at the lower UHF frequencies, but in such applications its full capabilities are being wasted.

The advantages of the disc-seal construction, enumerated above, are only realised in cavity or coaxial circuitry which makes intimate electrical and thermal contact with the entire outer edge of the disc-seals. The evolution of a simple cavity oscillator circuit from the single and double-ended circuits of Figs. 1 and 2 is shown in Fig. 4.

Thus, the cavity circuit may be thought of as a "multiple-ended" circuit in which the number of resonant circuits connected in parallel is made infinite so as to form a solid wall completely enclosing the rf fields. In such circuits the losses due to radiation are very small. A special by-pass condenser is built into the base of the tube to block dc bias voltages but connect the cathode "shell" to the cathode for rf.

A more practical circuit of the coaxial type is illustrated in Fig. 5. This arrangement uses two resonant coaxial circuits, one connected between the grid and cathode, and the other between grid and plate. The circuit is therefore analogous to the tuned-plate, tuned-grid circuit.

Because the grid is at rf ground, and forms an effective electrostatic shield between the input and output circuits, the circuit will not function as a self-excited oscillator unless feed-back is intentionally introduced by coupling between the two cavities. Without provisions for rf feed-back, the circuit functions as an effective grounded-grid amplifier.

Tuning is accomplished in coaxial circuits by means of movable shorting "plungers" which vary the length of the coaxial resonator, and hence the resonant frequency, which is related to the length of the resonator by the expression:

$$(2) \quad \frac{1}{\omega C_0} = Z_0 \tan \frac{2\pi \ell}{\lambda}$$

Where:

C_0 is the tube capacitance shortening line
ω is 6.28 times the operating frequency.
Z_0 is the surge impedance of line.
ℓ is the length of the line.
λ is the wavelength.
2π is 360 degrees.

This equation may also be used to determine the approximate length of the parallel line resonant circuits used with single-ended and double-ended oscillator circuits. In the latter case, it must be remembered that only one-half of the lumped capacitance contributed by the tube is used in Eq. 2.

CONTACT PRINTS FROM MAGNETIC TAPE

MAGNETIC recording has a number of advantages over disc recording and, conversely, several disadvantages. One of its most serious drawbacks is the relative difficulty of duplicating recordings.

The announcement of a magnetic method of printing magnetic tapes by a process similar to that used for discs may herald a new advance in the acceptance of this new recording medium. A duplicating machine can turn out eight 1-hour reels every two minutes (using double-track tape and running the tape at a speed of 10 feet per second).

The process is actually very simple. A recorded tape and a blank one are held in contact with each other and passed through a high-frequency magnetic field, called the "transfer field," which produces a distortionless magnetisation of the copy tape.

It has long been known that, if a blank tape is held in close contact with a magnetised one, it will pick up the magnetic pattern. But the recording so picked up is very weak and its level does not vary linearly with that of the "master." The transfer field changes all that. Level is within a few decibels of the master and distortion is low.

The master tape is made of durable material having high magnetic retentivity. Mechanical ruggedness is essential, as it may have to make thousands of copies. The requirements of high retentivity is due to the transfer field. If this field is strong, there is a tendency to demagnetise the master tape. Yet it is in just such a strong field that the best record is made on the copy tape. Good results are obtained with a copy tape of easily magnetised material and a transfer field held just below the point at which it demagnetises the master.

The copy is a mirror image of the master. This caused no difficulty in single-track tapes, but an attempt to play back some of the increasingly popular double-track and stereophonic recordings resulted in the copies always playing backward. To avoid this difficulty, the master record runs backward.

In a practical machine, the beginning and end of the master tape are spliced together to form an endless belt. The extra length of long tapes can be handled by winding around drums or in a number of other ways. The tape is then run through a number of copying heads, each with its own transfer field.

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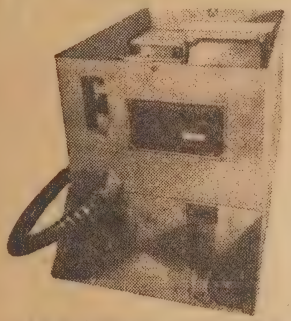

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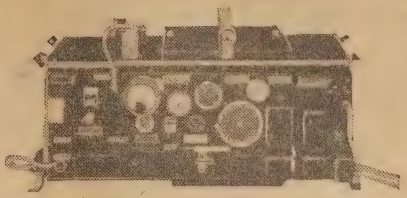

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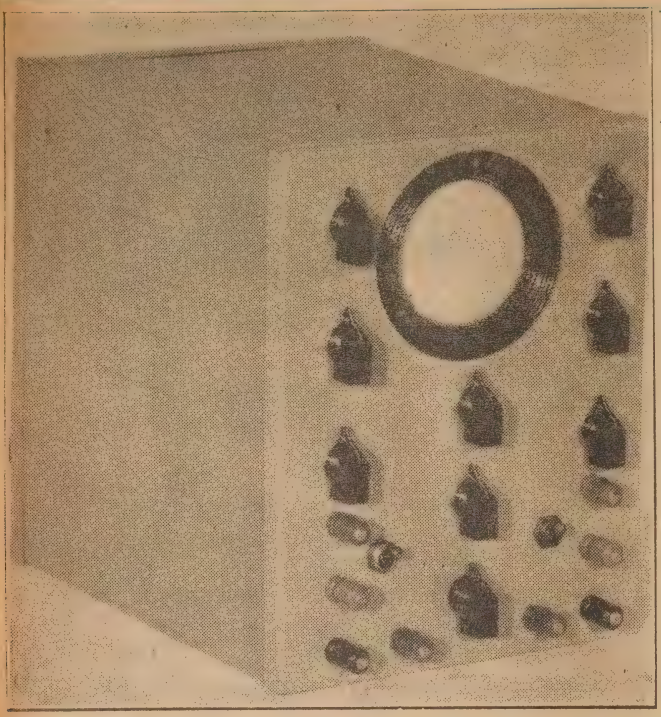


This photograph shows the neat appearance of the little CRO when fitted into its case. A handle can be fitted to the case, for ease of carrying, if desired.

LINEAR SWEEP FOR YOUR C.R.O.

Last month we described a small service oscilloscope which gave excellent results. This month we describe the addition of a linearising valve, which greatly improves the time base characteristic, particularly at low frequencies. Additions to the instrument include a few components and an extra triode or triode-connected pentode valve.

by Derrick Williamson

THE first question you will probably ask is: "What is non-linearity, and why is a linearising valve necessary to cure this trouble?" When it is stated that a saw-tooth wave-form is non-linear by a certain percentage, it is to be understood that the velocity of the spot is not constant as it traverses the screen.

This causes the pattern to become cramped on one side. Non-linearity occurs with any simple time base in which a capacitor is charged through a fixed resistance because of the exponential nature of the condenser's charging characteristic.

This means that, as the voltage on the condenser increases, the charging current decreases. In other words, the rate of charge becomes slower as the voltage across the condenser approaches the supply voltage.

The simplest way to improve this is to use a small portion only of the charge on the condenser, i.e., to allow the condenser to charge to, say, five per cent of the supply voltage before discharging it. This will result in a small degree of non-linearity, being improved still further by reducing the charge to, say, one per cent. Unfortunately, to obtain a reasonable output voltage, this scheme becomes impracticable as the supply voltage becomes very high.

The best solution to the problem is to charge the condenser through a constant current circuit, such as provided by a suitably connected pentode valve.

This type of lineariser operates on the principle that a pentode valve will pass a constant plate current for a wide range of plate voltage provided that the screen and control grid potentials are constant. When the grid or screen potentials are altered, the plate current will again assume a constant value of a magnitude different from that of the current flowing with the first setting.

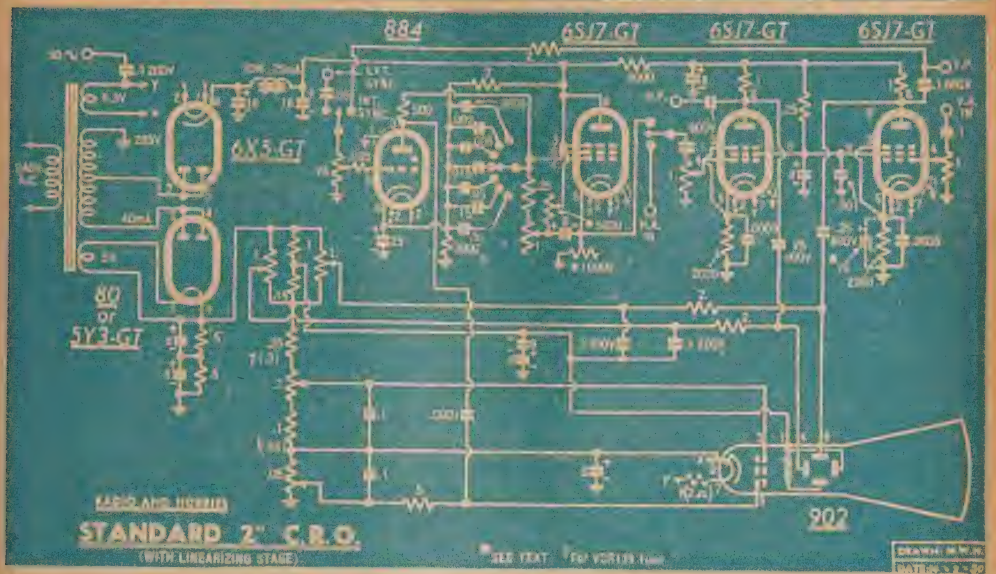
If, therefore, we substitute a pentode valve in place of the charging resistance, we will have a constant current-charging device, and fine frequency adjustment can be made by altering the screen voltage, and hence the plate current. The coarse frequency changes can be made as before by switching the capacitors.

As the characteristics of a pentode are virtually linear until the plate voltage falls below approximately 50 volts, an output voltage of approximately 250 volts can be obtained with a 300 volt supply source. This voltage can be increased still further if a higher supply is used and a gas triode capable of operating at the higher potentials is employed.

The high output capabilities of this type of time base enable it to be connected directly to the deflector plates of the oscillagraph if desired. This makes the output waveform of the timebase independent of the frequency response and distortion characteristics of the amplifiers. The length of the trace on the screen of the tube can be controlled, under these conditions, by altering the potential on the grid of the gas triode, thereby altering the point on the condensers' charging characteristic at which the gas triode conducts.

The trace with this type of time base can be made even more linear, if this is required for laboratory purposes, by using negative feed-back in the cathode circuit of the pentode. This feed-back takes the form of an unbypassed cathode resistor connect-

CIRCUIT OF SMALL CRO WITH LINEAR SWEEP



The simple additions required to add the linearising stage to the oscilloscope are clearly shown in this circuit diagram.

ed between the cathode of the pentode and earth. However, this application is usually limited to fixed frequency operation, as it is very difficult to keep the grid voltage constant with respect to the cathode when the frequency is varied by altering the tube plate current, and hence the voltage drop across the cathode resistor.

Another difficulty when feed-back is applied is to provide a sufficiently high supply potential to overcome the drop across the cathode resistor, which may be as high as 200 volts.

A time-base of the general characteristic described above, but without feed-back, was built up and tested. It proved to have excellent characteristics, even when operating at as low as eight cycles per second. Viewing a 50-cycle pattern, the linearity was excellent.

However, there are two major disadvantages to using this type of time base.

SEPARATE WINDING

The first and least troublesome of these is that it is necessary for the cathode of the gas triode to operate at a high potential with respect to ground. This necessitates connecting the heater of the valve to the cathode and operating it from a separate insulated filament winding.

This difficulty was overcome in our case by winding a small transformer on a speaker transformer core, having a primary operated from the normal 6.3 volt transformer winding, and a secondary which delivered approximately 6 volts under load for the gas triode's heater.

A filament transformer with a 240 volt primary could, naturally, have been used.

The second and more serious disadvantage is that a very high audio voltage is required to enable the time base to be synchronised. This high voltage is required to overcome the voltage drop across the linearising tube, as it is not convenient to apply the synchronising voltage between the grid and cathode of the gas triode.

To synchronise the tube effectively, it would be necessary to provide a separate amplifier to develop the high audio voltage required. For this reason, we decided to revert to a simpler linearising circuit.

The circuit finally used is identical with that used in the 5in CRO described in the February and March, 1948, issues of Radio and Hobbies. The operation of this circuit was described in these issues, and we can do no better here than repeat this information.

The pentode valve has been wired as a triode, although any medium or high-mu triode valve will perform equally as well.

PARTS LIST

In addition to the parts specified last month you will need the following:—

1 6SJ7-GT or similar valve.
1 8 mfd 525 PV electrolytic condenser.
2 20,000 ohm wire wound potentiometers.
1 valve socket to suit valve used.

Delete from last month's parts list
1 1 megohm resistor.

The success of the circuit largely depends upon how closely the gain of the valve approaches unity. Naturally, the value of the cathode resistor is a controlling influence in this factor, bearing in mind that, as the value of the cathode resistor approaches the a-c or plate resistance of the valve, so the amplification factor of the valve approaches unity.

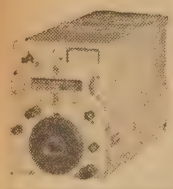
In this circuit, the 5000-ohm resistor from the plate to the positive side of the 8mfd electrolytic condenser is, in the a-c sense, really in parallel with the 10,000-ohm cathode resistor. Considering the impedance of the 8mfd condenser at, say, 20 cycles as being in the vicinity of 1000 ohms, it can be seen, by glancing at the circuit, that the impedance in parallel with the cathode resistor will be 5000-ohm resistor plus the impedance of the 8mfd condenser.

IMPEDANCE CHANGE

The resulting impedance will vary slightly with change in time-base frequency; hence the reason for the compromise in selecting the values of the two resistors for optimum degree of linearity over the time-base frequency range.

The function of the valve may be viewed in the following manner:—The 8mfd condenser at the cathode of the 6SJ7-GT is charged and maintained at reasonably constant potential by the 5000-ohm resistor from the HT supply. The particular time-base condenser selected by the time-base "coarse"-frequency switch is charged from the potential on the 8mfd condenser via the "fine"-

ESTERN ELECTRIC COMMAND TRANSMITTERS



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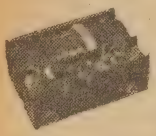

28 volt input D.C., regulated and filtered, output filtered D.C. 300 volts at .26 amps; 150 volts at .01 amps; 14.5 volts at 5.0 amps.

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6AG7	20/-	956	12/6
6B6G	10/-	9001	10/-
6H6GT	7/6	12A6	10/-
6SH7	8/6	12SG7	10/-
6SH7GT	8/6	12SK7	10/-
6SL7GT	12/6	12SR7	10/-
6SN7GT	12/6	EA50	7/6
6U7G	10/-	CV6	8/6
7193	8/6	VT90 Micropop	10/-

NEW VALVES

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6B6G	12/6	7C7	11/6
6B8	15/-	7F7	11/6
6B8G	12/6	83V	11/-
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4 mfd. 400VW	6/-	0.5 mfd. 200VW	1/-
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frequency control, the 1-megohm variable resistance in series with the .25-megohm resistor.

At the commencement of the charge, the grid of the cathode follower is negative with respect to its cathode by reason of it being connected to the time-base condenser. As the charge on this condenser increases, its potential rises positively with respect to earth. At the same time, the grid of the cathode follower rises positively, causing this valve to draw more and more current. This increase in current increases the voltage-drop across the cathode resistor, which, acting upon the grid as an increase in negative bias, maintains the grid to cathode potential reasonably constant. Alternatively, it could be said that for each positive increase on the time-base condenser there is a closely corresponding increase at the cathode which, really, is an increase in the voltage between the positive side of the 8mfd condenser and earth.

CATHODE-FOLLOWER

The result of this cathode-following action of the valve is that the voltage drop across the charging resistance remains fairly constant. This means that the current through this resistance maintains the same constancy, resulting in a change from the original expotential law of the time-base condenser to one which is approximately linear.

The output from the time base may be taken from the 10,000-ohm cathode resistor or the 5000-ohm resistor. However, as the input to the time-base amplifier has one side at earth potential, the obvious point from which the output should be taken is the cathode.

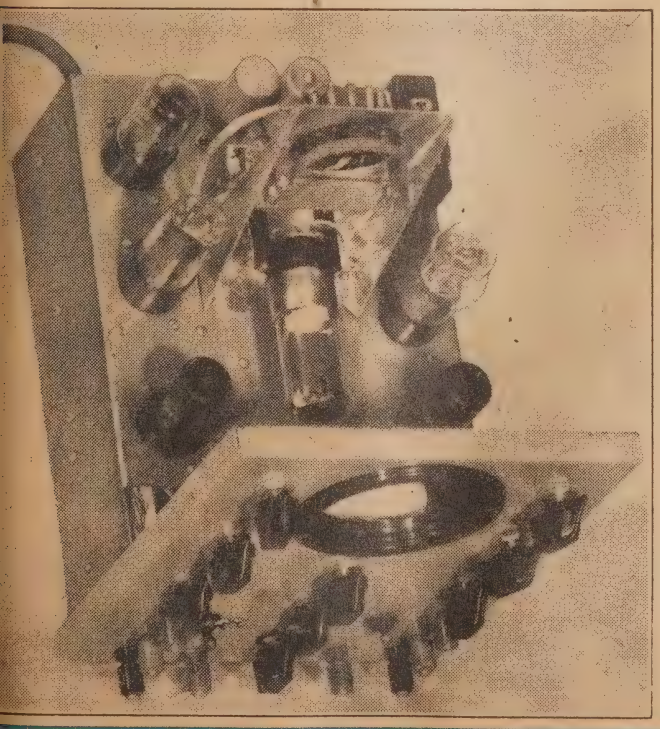
In adjusting these potentiometers for optimum linearity, it will be necessary to provide a means of noting the trace linearity, such as by feeding a sine wave into the Y plate or vertical amplifiers. Throughout the adjustment, arrange the frequency relationship so that there are at least three complete cycles appearing on the screen, and preferably four or five.

LOW FREQUENCIES

Commence by setting the cathode potentiometer at or near its maximum value. Then adjust the potentiometer from HT so that good linearity is approached at the very low time-base frequencies. At this juncture, it may be noticed that portion of the last cycle, or the last cycle when there are more than, say, six cycles appearing, is cramped, compared with the others. Reducing the value of the cathode potentiometer will correct this; but, in doing so, keep a check on the change in linearity at the very low frequencies.

By adjusting one potentiometer, then the other, positions will be found where the linearity is optimum throughout the time-base frequencies.

At the very low frequencies there is a limit to which the linearity can be adjusted. Beyond this limit the fly-back time is affected, resulting in portion of the trace appearing to double back on itself.



The position of the additional tube can clearly be seen from this photograph in which the CR tube has been removed. Details of the strap and bracket used to clamp the base of the VCR 139 can also be seen.

At high time-base frequencies, the brightness of the trace may not be uniform. Adjustment of the value of the resistor at the grid of the CRO will vary the amount of fly-back blackout and hence the relative brightness of both ends of the trace.

In the original circuit diagram of the C.R.O., published last month, we marked as optional the use of 25mfd bypass condensers across the amplifier cathode bias resistors. Further tests have shown that under no condition should the 25mfd condenser be used to bypass the horizontal amplifier cathode resistor. The use of a bypass in this position ruins the extreme low frequency response of the amplifier and makes the non-linearity intolerable at low time base frequencies.

The use of a bypass condenser on the other amplifier may still be retained, if desired, although in practice the gain of the amplifier is adequate without this condenser in circuit.

If you desire to use amplifier valves of the 6AC7 or 6SH7 type the unbypassed cathode resistors should be reduced to 1000 ohms.

And now for a few details of the method of installation.

VALVE MOUNTING

The first problem was to find a suitable place to mount the valve. It could not be mounted under the chassis behind the C.R. tube because of the power transformer. The place finally selected was on the C.R. tube bracket just below the tube. This position can easily be seen from the photographs. It allows for a minimum of alteration to the chassis, and short leads to the components beneath.

The position of the H.T. decoupling condenser for the amplifiers has been altered so that the two pre-set controls could be mounted on a small bracket in the corner of the chassis beneath the filter choke.

The shafts of these controls are cut short and slotted for screwdriver adjustment. Two holes are drilled in the back of the chassis to allow access to these controls. The 8 mfd electrolytic condenser associated with the pre-set controls is mounted directly on to them, supported by its own pigtail connections. The rest of the parts are mounted in the same positions as shown in the photograph in last month's issue.

The tube socket is mounted on two pillars approximately 1in long. This allows ample clearance between the socket connections and the metal mounting bracket. The leads from the socket pass through two holes in the chassis. To avoid coupling between the grid lead and other wires, it passes alone through one of the holes, while all the other leads pass through the other.

The leads from the front panel to

(Continued on Page 73)

PRICE'S RADIO 1950 BUYERS GUIDE

COIL KITS

R.C.S. Dual Wave coil bracket, w/o. RF stage	34 0
R.C.S. Dual Wave coil bracket, with RF stage	130 0
Q-PLUS. Midget Dual Wave Unit. A type to suit all converter valves	49 6

BROWN HEADPHONES

The Brown type "X" is a popular priced headphone that is ideal for the boy's crystal set. High impedance ensures efficient results. Complete with cord and headband.

£1/17/6

COILS, SHORT WAVE

R.F.P.	C11 Aer.	13/42 Metres	3 0
	C12 R.F.	13/42 "	3 0
	C13 Osc.	13/42 "	3 0
	C17 Aer.	9/30 "	3 0
	C18 R.F.	9/30 "	3 0
	C19 Osc.	9/30 "	3 0
	C20 Aer.	25/86 "	3 0
	C21 R.F.	25/86 "	3 0
	C22 Osc.	25/86 "	3 0
	C23 Aer.	78/200 "	4 6
	C24 R.F.	78/200 "	4 6
	C25 Osc.	78/200 "	4 6
	C26 Aer.	40/120 "	3 0
	C27 R.F.	40/120 "	3 0
	C28 Osc.	40/120 "	3 0
R.C.S.	H124 Aerial	10 "	4 6
	H125 R.F.	10 "	4 6
	H126 Osc.	10 "	4 6
	H127 Aerial	20 "	4 6
	H128 R.F.	20 "	4 6
	H129 Osc.	20 "	4 6
	H130 Aerial	40 "	4 6
	H131 R.F.	40 "	4 6
	H132 Osc.	40 "	4 6
	H133 Aerial	80 "	4 6
	H134 R.F.	80 "	4 6
	H135 Osc.	80 "	4 6

PLASTIC WIRE

A high grade plastic covered copper wire that will find a multitude of uses. Ideal for indoor aerials, extension speaker, leads, hook-up wire, etc.

25', 1/3 50', 2/6

TRANSFORMERS, AUDIO

R.C.S.	TB42. Class A. 3-1	21 0
	TB43. Push-pull	22 6
	TB44. Class B. Push-pull	21 0
Ferguson:		
1P1.	Push-pull. AB1	78 2
1P2.	" AB2	93 0
1P3.	" Class B.	102 0

EVEREADY DRY BATTERIES

No. 761 4½V. "C" battery	2 5
793 9V. "	3 3
U.14. Gaslighter Cell	3 8
701 3V. Cycle torch battery	2 1
703 4½V. Pocket Torch	1 8
915 1½V. Pen Torch unit cell	9d
935 1½V. Small unit cell	9½d
950 1½V. Large unit cell	9½d
467 67½V. Personal portable	14 10
482 45V. Minimax Battery	14 6
770P 45V. Superdyne Battery	24 4
741 1½V. Standard "A"	8 9
742 1½V. Small "A"	4 8
745 1½V. Minimax "A"	8 6
X250 1½V. Heavy Duty	23 2
X71 1½V. Square Telephone Cell	2 6
6 1½v. Standard Round Cell	5 0
Plugs for "A" batteries	3d
Plugs for "B" batteries	4d
Adaptors for "A" batteries	6d
Adaptors for "B" batteries	7d
Clips for 467 "B" batteries, per pair	2d

BATTERIES AND ACCESSORIES

Clyde accumulators can be supplied to order, fully charged, ready for use. 24 hours notice required.

Westinghouse Battery Chargers, 6 volt 5 amps	£6 12 9
Battery Hydrometers	6 9
Battery Clips. 25 Amp.	6d
" 5 Amp. Pee Wee	5d
" Alligator type	3d

THE "INVERNESS" 4 VALVE KIT SET

The "Inverness" is the most efficient valve set of its type that is available in kit form.

The circuit is a TRF, incorporating all those features that go to make a radio completely satisfying.

The kit is complete to the last screw, and includes valves, Rola speaker, cabinet and easy to follow instruction sheets.

£11/11/-

CONDENSERS, SEMI-FIXED

Philips Air Trimmers. 3-30mmF	2 9
R.C.S. Mica Trimmers. 3-30 mmF	1 3
R.C.S. Padders 5 plate (455 kc)	2 6
Jabel Mica Trimmers	1 3

CABLES, ETC.

Flat Twin Rubber per yd.	7d
Plastic, Flat Twin per yd	7d
2 Core Braided per yd	9d
3 Core Braided per yd	1 6
3 Core Rubber per yd	1 9

I.F. TRANSFORMERS

Q-Plus, Miniature. No. 1 & 2	13 9
Aegis. J9. Permatune. No. 1	13 6
J10. " No. 2	13 6
Labgear Miniature English. No. 1 or No. 2	12 6
R.C.S. IF170. Permatune No. 1	13 0
IF171 " No. 2	13 0
IF174 Low gain type Permatune	13 0

ALUMINIUM CHASSIS

Ideal for light weight equipment. 20 gauge with welded ends. Three sizes only.

12" x 7" x 2½"	7 0
8" x 6" x 2½"	5 6
6" x 4" x 2½"	4 0

TORCHES

Minilite Miniature Torch	4 6
Perlux Standard	11 6
Perlux Phospoglow	13 9
Perlux Unbreakable	13 9

NOISE SUPPRESSION CONDENSERS

For vacuum cleaners, fans, etc., that cause noise in the radio. For 240V. AC operation.

Ducon. 2X0.01 mF	8 6
" 2X0.1 mF	9 9

SUNDRIES

Magic Eye. Escutcheons	1 0
Fuses. 1A, 5A & 10A	6d
Fuse Holders	1 0
Lightning Arrestors	2 4

COLLARD RECORD PLAYER UNIT

New model just landed. It is lower in price, but an improvement on the earlier type. Powerful induction motor, rim driven turntable. Supplied complete with high grade magnetic pick-up which operates the automatic stop and start switch.

£5/8/-

GRAMO MOTORS

COLLARO. New model, rim drive fitted with light weight high fidelity pick-up with permanent sapphire needle	£7 4 0
GARRARD. Type "S" rim drive with standard magnetic pick-up	£6 2 6
COLLARO. Automatic record changer, will play either 10" or 12" or mixed. Fitted with good quality pick-up	£14 7 6

This buyers guide is for your convenience. If the previous pages have been mislaid, write for a complete copy. Remember all quotations are net and postage or freight is additional.

PRICE'S RADIO

5 & 6 Angel Place
SYDNEY

PRICE'S RADIO 1950 BUYERS GUIDE

ASSEMBLING & WIRING SUNDRIES

English Hook-up Wire in six colors . . . . per yd.	5d
Plastic Hook-up Wire . . per yd.	2d
Screws 1/8" x 3/8" or ¼" per doz.	4d
Screws 1/8" x 5/8" or ¾" per doz.	5d
Nuts, 1/8" Whit. . . . . per doz.	3d
Eyelets, Medium . . . . per doz.	2d
Eyelets, Large . . . . per doz.	3d
Lugs, Single Ended . . . per doz.	2d
Lugs, Double Ended . . per doz.	2d
Lugs, Small Loop type . . per doz.	3d
Solder, Resin Cored . . . per yd.	8d
Tinned wire, 16 Gauge . . per yd.	3d
Spaghetti, 1mm . . . . . per yd.	4d
" 1½mm . . . . . per yd.	5d
" 2mm . . . . . per yd.	6d
" 3mm . . . . . per yd.	8d
" 4mm . . . . . per yd.	10d
" 7mm . . . . . per yd.	1 3
Reducing Bushes, 3/8"-¼"	4d
Couplings, Flexible, ¼"	2 3
" Brass, ¼"	1 0
Extension Spindles, ¼" to ¼" . .	9d
" " 3/8" to ¼" . .	10d
" " 3/8" to 3/8"	10d
Grid Caps, GT type	1d
Standard type	1d
Insulated 807 type	1 0
Shielded Hook-up Wire, per yd.	1 0
Resistor Strip, with double row of lugs, 12" long	3 0
6" long	1 9
Anchor Strips, without feet.	
SM12. 1 Lug . . . . . per doz	1 0
SM13. 2 " . . . . . "	1 6
SM14. 3. " . . . . . "	2 0
SM15. 4 " . . . . . "	2 9
SM16. 5 " . . . . . "	3 3
SM18. 6 " . . . . . "	4 0
With mounting feet.	
SM22. 2 lug . . . . . per doz	1 6
SM23. 3 " . . . . . "	2 0
SM24. 4 " . . . . . "	3 0
SM25. 5 " . . . . . "	3 6
SM26. 6 " . . . . . "	4 0
SM27. 7 " . . . . . "	4 6
SM28. 8 " . . . . . "	5 0

TEST EQUIPMENT

University

DCM. DC Multimeter	£8 2 4
MK1 AC/DC Multimeter . . kit	£9 4 2
MVA/2 AC-DC Multimeter	£13 10 10
OK1. Oscillator Kit	£9 4 2
XAO. AC Oscillator	£21 12 3
XOB. Battery Oscillator . .	£20 10 6
O-1 mA Meters, Round type	£3 5 0
O-1 mA Meters, Square type	£3 15 10

MODULATION TRANSFORMERS

Ferguson Multi ratio models:—

M-25. 25 Watts	£4 5 0
M-50. 50 Watts	£5 11 0
M-50M. 50 Watts	£10 0 0
M-125M. 125 Watts	£13 16 0

The M series both 50 and 125 watts are suitable for any valve combination, within their power ratings.

TECHNICAL DEPARTMENT

Your inquiries, whether personal or by mail, receive the attention of a competent member of our staff.

Technical advice on your radio problems is available free. However, we cannot supply circuit diagrams except with kits of parts.

Special facilities are available for the design and development of most radio and electronic devices. If you desire something different in radio receivers, amplifiers, etc, we can build it to order for you.

Call or write for a quotation, you will find it reasonable.

TOY DEPT.

This section of our store specialises in toys for boys, and only the best makes are stocked.

HORNBY. Mechanical "O" gauge train sets.
Electric "O" gauge train sets.
"O" gauge rolling stock.
"O" gauge rail, points, crossings, signals etc.

"Dublo" miniature scale model electric train sets.
"Dublo" rolling stock, rails, points, etc.

MECCANO. Construction sets.
Accessory sets.
Spare parts.
Electric and clockwork motors.

DINKY. Non mechanical cars, planes, trucks, etc.

SUPER DINKY. Scale model trucks, tractors, etc.

MINIC. Realistic mechanical cars, trucks and novelties.

PENGUIN. Mechanical boats and rubber powered planes.

FLEET. Scale model railway fittings.

JUNEERO. For the junior engineering enthusiasts.
Etc., etc., etc.

HEADPHONES

Brown. Type "A". Adjustable reed movement. The world's best headphone	£7 4 3
Brown. Type "F". Feather-weight. A highly efficient light weight headset	£2 14 6

AMPLIFIERS

We can quote you for all your amplifier requirements.

5 Watt Standard Amplifier	£21 9 6
15 Watt Standard Amplifier	£24 5 9
30 Watt Standard Amplifier	£31 0 10

EDDYSTONE

Short Wave Components

Short Wave RF Choke . .	3 10
UHF " . .	3 3
Transmitting " . .	5 0
All Wave "	6 6
50 x 50 pF Split Stator Condensers	£2 14 9
Full Vision Dial	£1 18 4
3½" SM Dial (Black)	£1 12 3
3½" SM Dial (Silver)	£1 16 10
Flexible Couplings	5 0
Flexible Drive Shaft	11 11

VIBRATORS

Oak

6V. 4 pin. Non Sync:	23 0
12V. 4 pin. Non Sync:	23 9
24V. 4 pin. Non Sync:	27 6
4, 6 or 12 V. 6 pin. Sync:	28 5
24V. 6 pin. Sync	32 10
4V. 7 pin. Split reed	29 9
6V. 7 pin. Split reed	30 6

SUNDRIES

Porcelain Stand-off Insulators. Beehive type 2½" high	3 11
Standoff. Oval base. 1⅜" high . .	1 8
Standoff. Oval base. 2¼" high . .	3 2
Calstan Xmitter condenser 110/110 mmF. 3000 volt	£3 7 6
IRC Precision wire wound resistors:— 1 ohm to 0.25meg. 8/- to 23/9. 0.3 meg. to 1 meg. 25/- to 62/6.	
Spark plug Suppressors	3 6
Tarzan Grip " per tube	1 0
Durex Clear Tape. Small	1 3
Durex Clear Tape. Medium	2 6

ELECTRICAL

Space does not permit a list of electrical plugs, sockets, etc. These can be supplied at standard prices.

Hotpoint. Standard Irons	47 6
Hotpoint Special Irons	42 6
Hotpoint. Special Toaster	50 0
Hotpoint. Chevron Toaster	50 0
Hotpoint Jug	42 6

We are mail order specialists and your inquiries or orders will receive prompt attention. Goods can be forwarded C.O.D. by post within the Commonwealth. C.O.D. or Freight to Pay by rail within N.S.W. only. If your requirements are not listed, please write for our quotation.

PRICE'S RADIO

5 & 6 Angel Place
SYDNEY

AEROSTAT ROTARY on/off Switch

Self-cleaning, low resistance, sterling silver contacts.
Strong coil spring gives instant snap action.
Offset spindle and mounting bush.

(Chassis)
Offset spindle enables body of switch to be rotated about hole in chassis, thus enabling it to be fitted in conveniently, in conjunction with adjacent components.

This new Aerostat DPST switch is ideal for use on low voltages where current is very small and low resistance contacts are vital. Will improve performance of battery and AC radios, sound systems and electrical appliances using not more than 1 amp at 240v. AC mains.

More receiver manufacturers use Aerostat than any other brand.

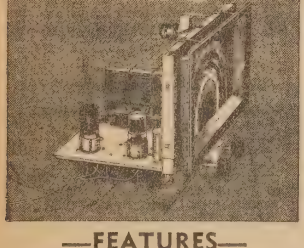
FACTORY REPRESENTATIVES:—

N.S.W. & Qld. **JAMES & VAUTIN,** 661 George St., Sydney. MA2437.

Vic. & S.A.: **R. E. TRICKEY & CO.,** 403 Bourke St., Melbourne. MU1263.

Manufactured by AEROSTAT (AUST.) PTY. LTD. 811 Prince's Highway, Tempe, N.S.W. LL1201-2-3.

AVAILABLE FROM ALL LEADING DISTRIBUTORS.



KC5 — The Leading 5-Band Electrical

BAND SPREADING

TUNING UNIT

Aegis does it again! This time it's a multi-band tuning unit, specially developed for the Custom Built Console of the modern lounge! The unit is actually the entire "Front End" of a radio receiver, completely assembled and wired and accurately calibrated in megacycles and aligned. For those who are especially keen on listening to exciting Overseas Broadcasts direct from their origin, plus hundreds of Amateur Radio Operators talking to one another all over the world, small ships at sea, aircraft, police, and standard broadcast Interstate, we highly recommend the Aegis KC.5. Tuning on the Shortwave Bands is just as easy as tuning the Broadcast. Once a Station is logged on this beautifully clear dial, you can rest assured it will appear at the same position next time.

—FEATURES—

- Complete coverage of all popular bands obtained with FIVE SWITCH POSITIONS. (550-1630 Kc.), 3.4-4.05 Mc.), 5.8-7.5 Mc.), (9.4-12.3 Mc.), (13.9-18.2 Mc.).
- Bands indicated on dial include 16, 19, 20, 25, 31, 40, 49, 80 Metres, and Standard Broadcast.
- Multi-coloured, full vision, illuminated dial, 12½ inch x 7¼ inch.
- Band change switch operates Automatic Band indicator on dial face. Fly wheel spin tuning shaft.
- Provision for "Magic Eye" tuning indicator.
- Positively no back lash on dial drive with 29 : 1 ratio.
- Special Perspex dial pointer prevents incorrect logging.
- All coils possess high quality, adjustable iron-dust cores.
- Trimmers have high "Q" factor.
- Best quality Moulded Mica, Ceramic, and Paper Condensers incorporated in circuit.
- I.R.C. Resistors used throughout.
- Stabilised Voltage Control on Screens of both R.F. and Converter Valves.
- R.F. Stage on all wave bands.
- Something new and exclusive in Dial Escutcheons.
- A.W.A. three-gang Tuning Condenser floated on rubber.
- Whole unit may be mounted on four rubber grommets when attached to chassis.
- All associated resistors and by-pass condensers included, complete.
- Any number of valves and control circuits can be built around this unit to give the desired results. (We recommend two I.F. stages using Aegis J20 and J21 I.F. Transformers.)
- Only five connections to make, to feed into any 455 Kc. I.F. channel.
- Gold Letter Station Transfers for all Australian Stations supplied.

AEGIS MANUFACTURING CO. PTY. LTD.

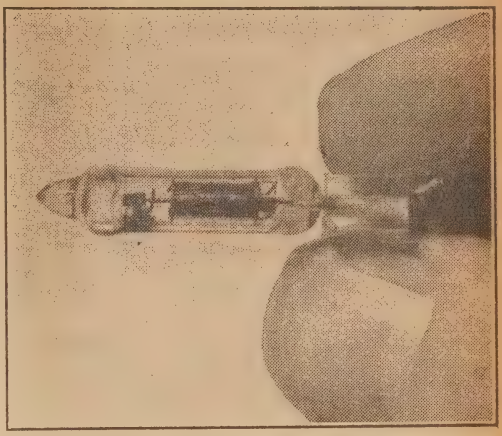
208 LITTLE LONSDALE STREET, MELBOURNE

Agents in all States

TRADE REVIEWS AND RELEASES

MULLARD RELEASE SUB-MINIATURE VALVES

Intended primarily for use in Hearing Aids, a new line of flat sub-miniature valves released by Mullard are claimed to be the smallest in the world. They are one-fortieth the size of a standard receiving tube.



The Mullard flat sub-miniature DF66 valve, fitted into a standard sub-miniature base. The size can be gauged from the fingers holding the valve.

THE overall dimensions quoted are one-third inch wide, one-quarter nch thick and just over an inch ong, this latter dimension varying vith the type. They have no base, he lead wires being normally sol- lered directly to the circuit points nd providing mechanical support or the valves. If desired, a sub- niniature socket can be employed.

Another feature is that the fila- nent current of all types is only 5 milliamps, the voltage being 0625 for the voltage amplifier and .25 for the output valve. Thus a hree-stage audio amplifier requires .25V. at 30 mA. for the filament ircuit or, alternatively, 2.5V. at 5 mA.

With this modest drain, it is pos- ible to develop a complete Mono- ack hearing aid weighing less than ounces and providing a useful ife of between 36 and 60 hours be- ore replacement of the A battery ecomes necessary.

The two valves at present avail- ble are the voltage amplifier pen- tode DF66 and the output pen- tode DL66. Both are designed for use with a 22.5-volt H.T. battery and are characterised by free- dom from microphony. Using a 22.5-volt H.T. battery, the DF66 will give a voltage gain of about 30dB per stage. This represents an increase of one or two dB on the earlier series of miniature valves.

The DL66 will give an output of approximately 2.5mW at no more than 10 per cent distortion. This is sufficient to meet the demands of 70 per cent of the hearing aids at present being manufactured.

Further details of these interest- ing valves may be obtained on appli- cation to Mullard-Australia Pty. Ltd., 35-43 Clarence St., Sydney.

BREVILLE UNIVERSAL PORTABLE

Operation either from internal batteries or the A.C. power mains, a new Breville portable sets a standard in both appearance and per- formance.

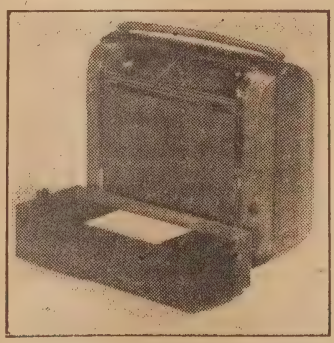
THE receiver itself is housed in an attractive leatherette-covered abinet, with a beading of anodised netal. A sliding metal shutter pro- ects the dial when the set is not in se.

Controls include tuning and vol- me while a 3-position switch gives choice of "treble," "medium" and bass" reproduction.

A similar switch at the other end f the escutcheon controls the bat- eries and has a special "economy" osition. This reduces slightly the naximum power output of the set ut effects a worthwhile saving of attery drain. In most cases, the eceiver can be operated normally n this position.

The circuit is built around five niniature battery valves and fol- ows along standard lines. A large peaker is used, however, which nsures plenty of volume under all onditions. Volume and tonal ualities are outstanding for this ype of set.

For A.C. operation, the receiver s placed on a shallow platform ontaining the A.C. power supply.



A plug and socket automatically makes these necessary internal con- nections, so that the receiver can be operated from the mains with- out imposing any strain on the batteries.

The A.C. unit can be carried sep- arately or clipped to the base of the receiver, as desired. The set is available through Breville distribu- tors in all States.

EKCO SOLDER PENCIL

The Ekco solder pencil is the latest contribution to the art of making soldering easy. Slightly larger than a pencil, it weighs only 2½ ounces, but will do most soldering jobs.

THE solder pencil operates norm- ally from either a 6-volt accumu- lator or a 6-volt mains transformer and draws less than 2 amps. Operat- ing heat is reached within 50 seconds, making the pencil an ex- cellent proposition for radio service- men or for others who find a stan- dard iron unduly cumbersome.

Since the heating element is con- tained entirely within the bit, the handle remains cool and fine work can be done without danger of damaging adjacent wiring.

The construction of the iron allows it to be placed directly on the bench or floor without fear of causing damage. Replacement elements are in the form of a card of wire which is long enough to make three ele- ments. The element is re-wound by the user, thus avoiding the long de- lays normally experienced when having standard irons repaired.

The solder pencil retails for 35/6 (plus tax) and replacement parts are available for a modest charge. Manufactured in England, the Ekco solder pencil is available from J. H. Magrath & Co., 208 Little Lonsdale Street, Melbourne.

SPAGHETTI!

Genuine woven spaghetti tubing, unaffected by heat, etc. Ideal for set constructors, servicemen, motor mechanics.

All prices reduced.

1½ mm	4d per 3ft. length.
2 mm, 2½ mm, 3 mm	6d per 3ft length.
4 mm, 5 mm	9d per 3ft. length.
7 mm, 10 mm, 12 mm	1/- per 3ft. length.
15 mm, 20 mm, 22 mm, 27 mm	1/6 per 3ft. length.

Extra special price for large quantities.

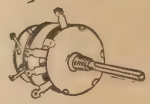
COILS

Popular Brand. Reduced to bedrock price.

Reinartz unshielded 3/-
R.F. with reaction shielded 3/-
Aerial Shielded 3/-
R.F. " 3/-
Osc. " 3/-
Kingsley miniature I.F. Transformers. Usual Price 13/9. Our Price, each 6/9
Kingsley miniature Aerial Coils 3/6
Kingsley miniature Oscillator coils to suit 6SA7, etc 3/6
Kingsley KIF9 and KIF10, 1900 Kc. transformers reduced to 5/11 each.

KINGSLEY VOLTAGE DIVIDERS

Brand new and in perfect condition. Available in 15,000 and 25,000 ohm sizes.
Usual Price, 5/6.
OUR PRICE, each 2/9

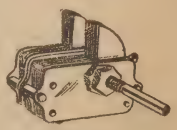


POTENTIOMETERS

Well-known make of Pots, with D.P. Switch. All brand new, with long shaft. Sizes 100,000 and 250,000 ohms. Usual Price 9/6. OUR PRICE, each .. 4/9

SWITCHES

Single bank, 2-pole, 5-position, long shaft, illustrated. Usual Price, 6/11. Our Price .. 4/9
Four Bank, well worth 15/-.
OUR PRICE 4/-

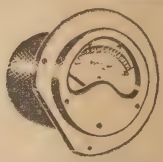


MINIATURE 2-GANG CONDENSERS

Popular brand, size 1¼ x 2 x 1 3/8, suitable for broadcast reception. Ideal for small mantel sets, personal portables, etc. Usual price, 19/3. Our Price whilst they last 12/6

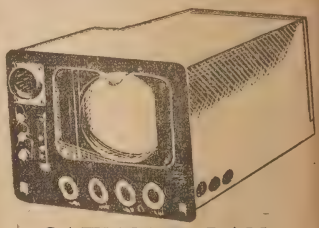
PLEASE NOTE

All parcels will be sent registered post unless otherwise stated. Postage or freight must be included with order.



A.C. METERS

0-30 amp. A.C. or D.C. adjustable moving iron ammeters, in heavy metal case, as illustrated. Overall diameter 6in.
Usual Price, £7/10/-.
OUR PRICE, each 30/-



CATHODE RAY INDICATORS

Unit Type A1.

This unit can be ideally converted to an oscilloscope. The parts alone are worth more than double the price listed.

Includes: 1—5BP1 valve complete with socket and nu-metal shield.
6—6AC7 (1852) valves, 3—6H6 valves.
12 Potentiometers.
10 Block Condensers.
40 1 watt IRC resistors.
1 3-position switch.
1 Toggle switch.

All enclosed in a neat metal box as illustrated. Easily worth £25.
OUR PRICE £8/10/-

M/S Motor Spares Ltd

547 ELIZABETH ST. MELBOURNE.

NEW LENS FOR T.V.

A REVOLUTIONARY lens has recently made its debut in the US. It is a lens without lenses—a unique telephoto unit designed by Dr. Frank G. Back, creator of the Zoomar lens, to bring sharp, ultra close-up of sports and news events.

In the new "Videio-Reflectar," as Dr. Back calls his new 40-inch lensless lens, the optical trick is accomplished with mirrors. Four special reflectors bounce the light beams back and forth to obtain magnification, that is said to be so high that the figure of a man more than a block away from a TV camera completely fills the screen.

Up till now, extra long-focus telephoto lenses were out of the question as far as TV pick-ups were concerned. A lens with a focal length of 25 inches (which by old standards meant that it had to be at least 25 inches long) were about the longest that could be used. Longer focal-length lenses were too heavy and too long, which meant they were not only shaky, but projected into the fields of other lenses used on a camera's turret.

The new unit is said to overcome all of these objections. It is only 16 inches long in spite of its 40-inch focal length. It weighs only 6 pounds, no more than many other TV lenses. It can be mounted directly on a TV camera turret with other lenses without interfering with their operation. (Radio and Television News).

A LINEAR SWEEP FOR YOUR CRO

(Continued from Page 67)

the grid of the gas triode and from the fine frequency control to the preset potentiometer, should be kept as far as possible away from other wiring. Also do not run any of the time base wiring close to that of the deflector plates, as even a small amount of coupling here will cause trouble.

A slight amount of ripple was noticed on the trace, which was found to be coming from the low voltage power supply. This trouble is caused partly because the power supply uses a half wave rectifier and mainly, in our case, because we used a pair of 8 mfd filter condensers.

Increasing the value of these to 16 mfd virtually eliminated the trouble, but if you can buy 24 mfd 350 volt or 525 volt condensers you will have no worry in this respect.

The two variable resistors used in the linearising circuit are marked with their nominal values of 5000 and 10,000 ohms. They actually consist of two 20,000 ohm wire wound potentiometers and should be adjusted to give the best results as set out above. The values shown on the diagram will give you some guide as to the final setting, although the exact value will depend upon the type of valve used.

Next month we may be able to describe the addition of a pentode linearisor, complete with synchronising amplifier. The unit will use two of the new miniature A.C. valves and should be capable of excellent results.

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ROD 1/16" 10d per ft, 1/4" 1/3 " ", 3/8" 1/5 " ", 1/2" 1/8 " ", 5/8" 1/11 " ", 3/4" 2/10 " ", 1" 4/3 " " — Any length to 48"

TUBE 1/4"OD x 1/8"ID 11d per ft
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1/2" " x 3/8" " 1/3 " "
5/8" " x 1/2" " 1/5 " "

TUBE 3/4"OD x 5/8"ID 1/10 per ft
1" " x 7/8" " 3/1 " "
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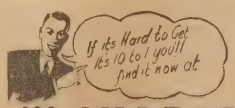


L.G. WALLACE

108 CHAPEL ST. WINDSOR S.1

VICTORIA

A READER BUILT IT!

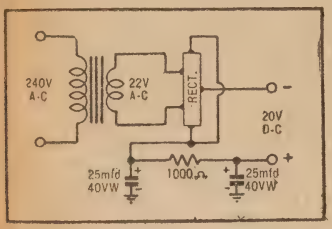
Gadgets and circuits which we have not actually tried out, but published for the general interest of beginners and experimenters.

A-C SUPPLY FOR THE 1Q5-ONE

A reader from Ravensworth, NSW, devised this simple little high-tension supply for one valve sets. The idea can be followed up, even if you have to improvise some other type of transformer.

THE original supply was built up for the 1Q5 One receiver, although it could obviously be used for any other one-valve set.

The unit was built up in the case of an old-type Philips trickle-charger—the type which used a 1018 rectifier



valve. There are still some of these in second-hand radio shops, and the only point is to see that the transformer windings are OK.

The whole of the internal wiring must be removed, with the exception of the wiring from the built-in switch to the primary of the transformer. It will be found that the secondary winding has a tapping near one end for the rectifier filament. Ignore this and use only the extreme ends of the winding when it gives a reading of 22 AC volts.

The rectifier was built up from a small 12-plate half-wave unit, such as is quite plentiful wherever disposals equipment is sold. The plates were rearranged in four blocks of three plates, each to form the well-known bridge circuit, and extra lugs inserted between each set of plates for the extra connections. (You could probably obtain a suitable bridge rectifier straight out and save this bother.)

The "choke" is simply a 1000 ohm resistor, while the filter condensers are two midget 25 mfd. four-volt electrolytics.

The rectifier is bolted to a metal plate in the position originally occupied by the 1018 rectifier valve, and the 1000 ohm resistor and the condensers are mounted around the rectifier. The output is wired to the plug sockets provided on the charger top.

The case will just fit nicely over the components if they have been assembled closely, and the result is a compact and efficient low voltage power unit, fitted with its own power switch.

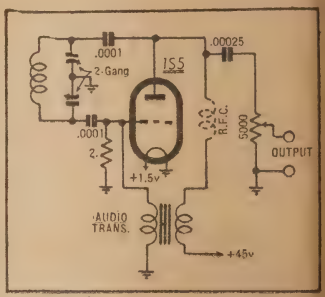
The completed unit gives a d-c voltage of 20 volts on load, and is a 100 per cent success for driving the 1Q5GT one-valve set.—(L. V. Griffin, c/o Post Office, Ravensworth, NSW.)

AN anonymous reader sends in a hint on an easy way to clean the dirt and metal filings out of a file.

He says that to clean a file he simply places a strip of adhesive tape lengthwise over the file. This is rubbed with the finger so that the adhesive side of the tape is pressed well into the file teeth. When the strip of adhesive is pulled off, most of the filing and dirt will come with it; however, in some cases it may be necessary to repeat the operation two or three times to thoroughly clean a dirty file.

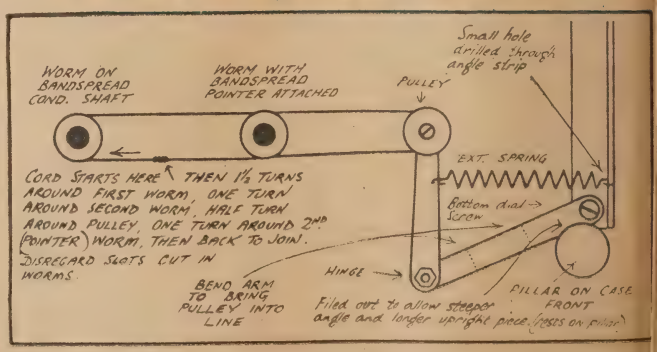
SIMPLE OSCILLATOR

USING the windings from standard coils or IF transformers, this simple oscillator will supply a modulated signal for alignment purposes. It is normally necessary to experiment with the transformer connections and grid circuit constants to



obtain a suitable modulating tone. The circuit, otherwise, is straightforward.—(From L. Goodwin, Snug, Tasmania.)

"CREEP" IN BANDSPREAD DIAL


WORM ON BANDSPREAD COND. SHAFT
WORM WITH BANDSPREAD POINTER ATTACHED
PULLEY
Small hole drilled through angle strip
EXT. SPRING
Bottom dial screw
CORD STARTS HERE ↖ THEN 1½ TURNS AROUND FIRST WORM, ONE TURN AROUND SECOND WORM, HALF TURN AROUND PULLEY, ONE TURN AROUND 2ND (POINTER) WORM, THEN BACK TO JOIN.
DISREGARD SLOTS CUT IN WORMS
HINGE
BEND ARM TO BRING PULLEY INTO LINE
Filed out to allow steeper angle and longer upright piece (rests on pillar)
PILLAR ON CASE FRONT

IN some commercial short-wave receivers, the bandspread dial is driven from the central mechanism by a long cord, the latter being kept taut by a light spring.

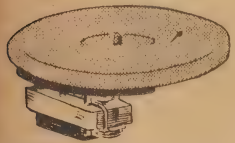
Temperature and humidity changes cause the cord to vary its length, and, since the tension spring operates on only one end of the cord, the bandspread dial is likely to vary a couple of points either way, with weather changes.

One reader has overcome the trouble in his own set by installing a new tension device, as illustrated. A longer cord is used, which passes round an extra "idler" pulley. This is attached to a free arm and sprin loaded to maintain tension on th cord.

Any variation in the length of th cord affects both sides equally an greatly reduces a "creep" in th bandspread dial reading. The schem can obviously be varied to suit dif ferent mechanical arrangements.- (J. L. West, 109 Spensley St., Clifto Hill, N8, Vic.)

Maxwell's Radio

ENGLISH ELECTRIC GRAMOPHONE MOTORS



210/250 Volts 50 Cycles AC Well-known English manufacture. This easy-to-mount motor is complete with turntable and mounting instructions.

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5 Valve Senior Portable Kit Set

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0-20 Volt. 0-200 Volt.
Made in England.

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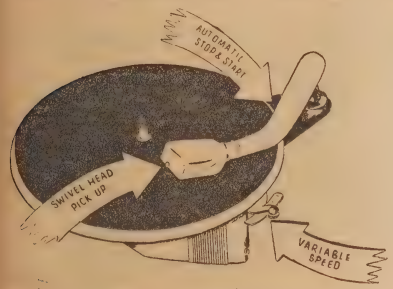

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- Late type pickup with adjustable head.
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(Freight 4/9)

Lidstays

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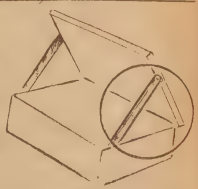
8" – 5/4



GARRARD Record changer

AUTOMATIC Changer for 10" or 12" Records.

Features: Lightweight magnetic head.
Simple to operate.
Easy to install.
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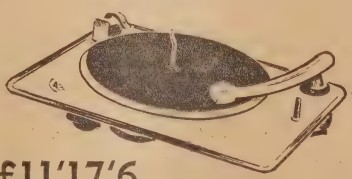

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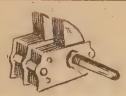

F/N Two Gangs 9/6

COLLARO R.C. 49 RECORD CHANGER

£13'19'6

This AUTOMATIC Record-Changer will play 10" and 12" records mixed.

FEATURES:
Crystal Pickup.
Ball bearing mounted turntable.
3-Point floating suspension.
Switch control for (a) reject record (b) repeat record (c) stop (d) unloading of records.
Works off voltage ranging from 100 volts to 250 volts.

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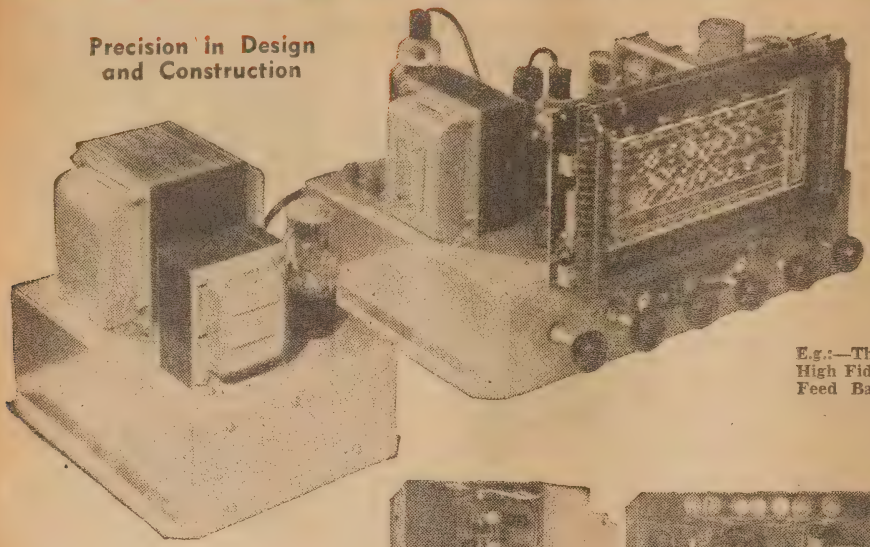
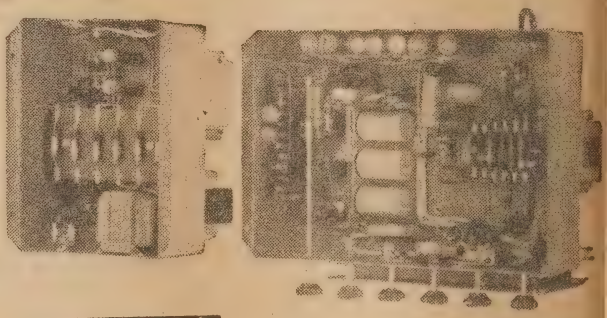


E.g.:—The Williamson High Fidelity Negative Feed Back Amplifier.



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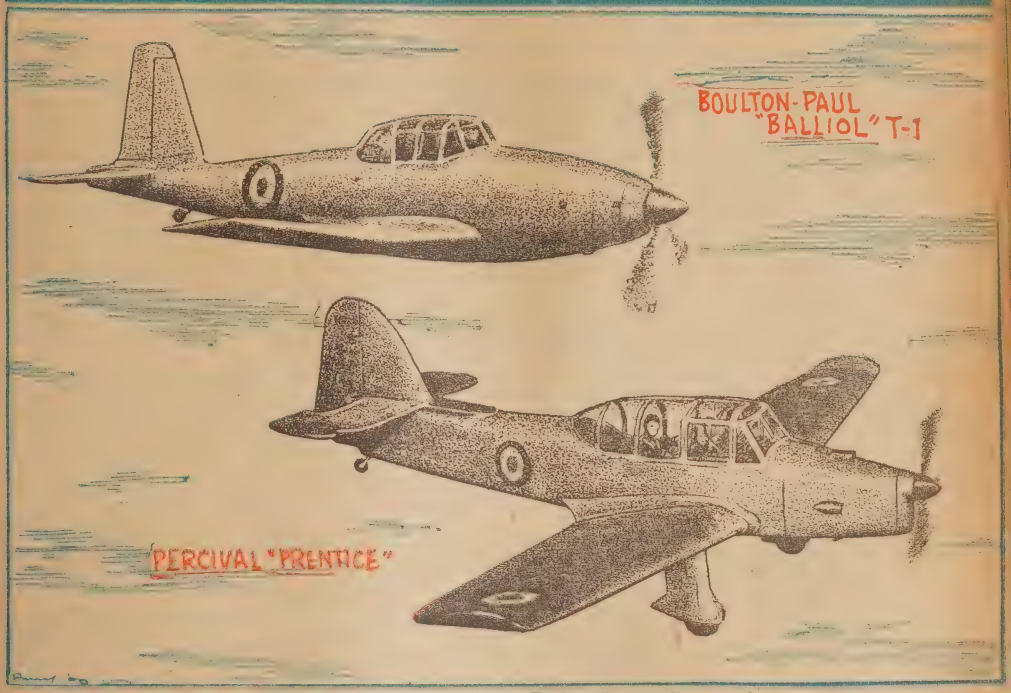
TWO FINE NEW BRITISH TRAINERS



Training aircraft, in which future airmen first "take the air" and learn the complicated art of flying, are as specialised in design as combat types. Sturdiness and a high degree of serviceability are among the characteristics sought, and with the development of newer and faster fighters and bombers, a higher degree of specialism among trainer types has developed.

AMONG Britain's many fine trainers are the Percival "Prentice," recently adopted as the RAF's basic trainer, and the Boulton-Paul "Balliol" T-1, an advanced type powered by a gas turbine.

First prototype of the three-seat Percival P.40 "Prentice" (lower) was flown just four years ago. As a result of trials, a number of modifications have been incorporated in the design of the production aircraft, including up-turned wing tips, redesigned control surfaces, and provision of an anti-spin extension to the tailplane.

A basic trainer, the Prentice is an all-metal cantilever low-wing monoplane.

The fuselage consists of a front portion of rectangular section extending back to the rear of the cockpit, and a rear portion of flattened elliptical section.

The tail unit features particularly large control surfaces—tailplane and elevators covering 57.3 square feet; fin 21.3 square feet, and rudder 18 square feet.

Pneumatically-operated split trailing-edge wing flaps in three sections are fitted between the aileron and fuselage on each side.

Power is provided by either a DH Gipsy Queen 32 or a Gipsy Queen 51 engine. A DH two-blade constant-speed airscrew is fitted. Maximum speed at sea level is 150 miles an hour.

Takeoff run to clear 50ft from grass is 390 yards with a Gipsy Queen 32 engine and 420 yards with a Gipsy Queen 51. From concrete the figures are 365 yards ("32") and 360 yards ("51"). Range at 138 miles an hour is about 500 miles at 5000ft in each case.

Main dimensions of the Prentice are: Wing span 46ft, and length 31ft 3in. Empty weight is 3080lb.

A low-wing monoplane, the Boulton-Paul Balliol (upper left) has remarkably good manoeuvrability and control characteristics, comparable with those of modern single-seat fighters.

It is suitable for all forms of advanced training, including flying, navigation, gunnery, bombing, photography and glider towing. One or tw trainees can be carried in addition t the instructor.

The main wheels retract and th fixed tail wheel is steerable.

The fuselage is of circular cross section and all metal structur throughout, terminating in a detach able Perspex tail cone. The cockpi section incorporates a stiff frame be hind the seats, forming a crash pylon and a rubber-sprung skid is built int the lower portion to limit damage i the emergency landing with landin gear retracted.

Fitted with either an Armstron Siddeley Mamba or a Rolls-Royc Dart airscrew gas turbine engine, th Balliol has a top speed over 300 mile an hour. A de Havilland constant speed full-feathering airscrew is fit ted.

With the Mamba, which gives 101 shaft horsepower plus 320lb exhaus thrust at sea level, the Balliol's ser vice ceiling is 36,750ft. Takeoff dis tance to 50ft, is 510 yards, and land ing distance from 50ft, 650yards.

Main dimensions are: Span 39ft 4in and length 36ft 6in. Weight, empty, i 5732lb.

ANOTHER FINE MODEL HELICOPTER

Having read our article last month on the He licoptoplane your appetite for such machines may have been whetted to the degree of trying something more ambitious or, on the other hand, you may have felt that it was too elementary in which case this is the job for you.

THE design of this helicopter is basically that which has been solved by two Americans—Frank Ehling, a noted model journalist and record holder, and Merrick Andrews, one of the top-line indoor model flyers.

Basically the model consists of a large propeller constructed in somewhat the same fashion as propellers used in the early days of flying. You will undoubtedly notice the similarity of the props on Wright's famous biplane, which is credited with being the first successful flying machine in the world.

To this propeller is added the motor sticks which carry the rubber motors, tailplanes, and propellers. The net result is that when the propellers are wound up and then released, they spin the machine around and around in a horizontal plane, and the centre portion, which is in effect a large propeller, then exerts lift in a vertical direction and the model commences to climb vertically into the sky.

WEIGHT LOW

The length of flight is governed to a large degree by the propeller run, and so we endeavor to keep the weight low and use only sufficient power to give a sweet, steady climb.

This is more effective than an overpowered model, which literally screams into the air and, in the process, virtually pulls itself apart, due to its excess power and speed.

After the propellers run down, the model commences its earthward descent and, unlike most helicopter models, it is rather stable, and floats quite slowly downward. On a day on which we find thermal activity it can even soar from sight in similar fashion to our duration models.

The materials required are very few, but it is essential that the best quality balsa wood be used for motor sticks, wing-ribs and spars, while the lighter and softer grades will prove quite adequate for the propellers and tailplanes.

Materials required:

- 2 x 1-8 x 1-8 hard balsa
- 2 x 3-16 x 3-8 hard balsa
- 3 x 12 x 1-16 medium to soft balsa
- 3 x 12 x 1-16 hard balsa
- 2 blocks 10 x ¾ x 1¼ medium balsa
- One small piece of aluminium
- Small quantity of .040 wire.

Having cleaned the workshop bench, take your drawing paper and scale up the drawings to full size — that is, four times as large as the plans shown. Work to these plans for an accurate and successful model.

Perhaps the most important thing to watch is the angle which is built into each half of the large centre propeller or rotor.

First pin down the rotor spars on the plan and then cut out the required number of ribs, using a metal template and cutting round it with a sharp-pointed knife to secure the correct shape.

Fit these ribs in place on the plan by cutting off portions of the trailing edges to match the required taper in the rotor blades.

CAREFUL PLACING

Be careful to see that you place the ribs correctly in each half—that is, with station marked X to the direction in which each leading edge turns. As you can see, station X faces in opposite directions on each half of the rotor.

Having assembled the ribs to the spars and satisfied yourself that all is well, you now securely cement each rib in place. After the cement has hardened sufficiently, I suggest you re-glue every joint, and allow overnight drying, because the finished rotor must be flexible yet strong, as it has to carry the stresses and strains imposed by two propellers pulling it around on its axis.

Before covering the rotor, the correct set must be given to each blade, as indicated in the plans. This is best done by breaking each spar at the centre with a slight green break, that is, just break slightly so that the spars do not come apart.

Adjust this break so as to secure the correct angles or set to the rotor, and liberally coat with cement, and allow to dry.

IMPORTANT ANGLE

This angle is important, but a difference of two degrees either way from the plans will not have any appreciable ill-effect on the performance.

You may now cover the rotor. Note that a small portion of the centre is left uncovered. The covering is best done with model tissue attached to each rib and the leading and trailing edges with photographers' adhesive paste.

by

Jack Finneran

Do not attempt to tighten the covering by spraying with water or dope, otherwise you will finish up with a badly warped rotor blade and also you will lose that flexibility which is so necessary in a helicopter.

The construction of the motor sticks is self-explanatory, as it is only necessary to cement the rear hooks and thrust-bearings in place. To save weight, the portion of the stick behind the rear hook is tapered away and the tailplane is cemented in place.

The tailplanes are smoothly tapered 1-16 inch balsa with a slight upturning at the trailing edge as indicated on the plans. This up-turning can be secured by brushing a small quantity of model aircraft dope on this portion of the top only, as when the dope dries out it will warp the trailing edge up slightly.

Having completed the motor sticks and cemented the tailplanes to them, we now attach the rotor as indicated on the plans and set aside for the cement to dry.

The propellers are next, and, as always, are very important. Good propellers mean a lot to the ultimate performance of any flying machine.

If you have any doubts as to your ability re the construction of propellers, I would suggest you visit any of the model hobbies stores and you should be able to secure ready-made ones at quite a reasonable figure.

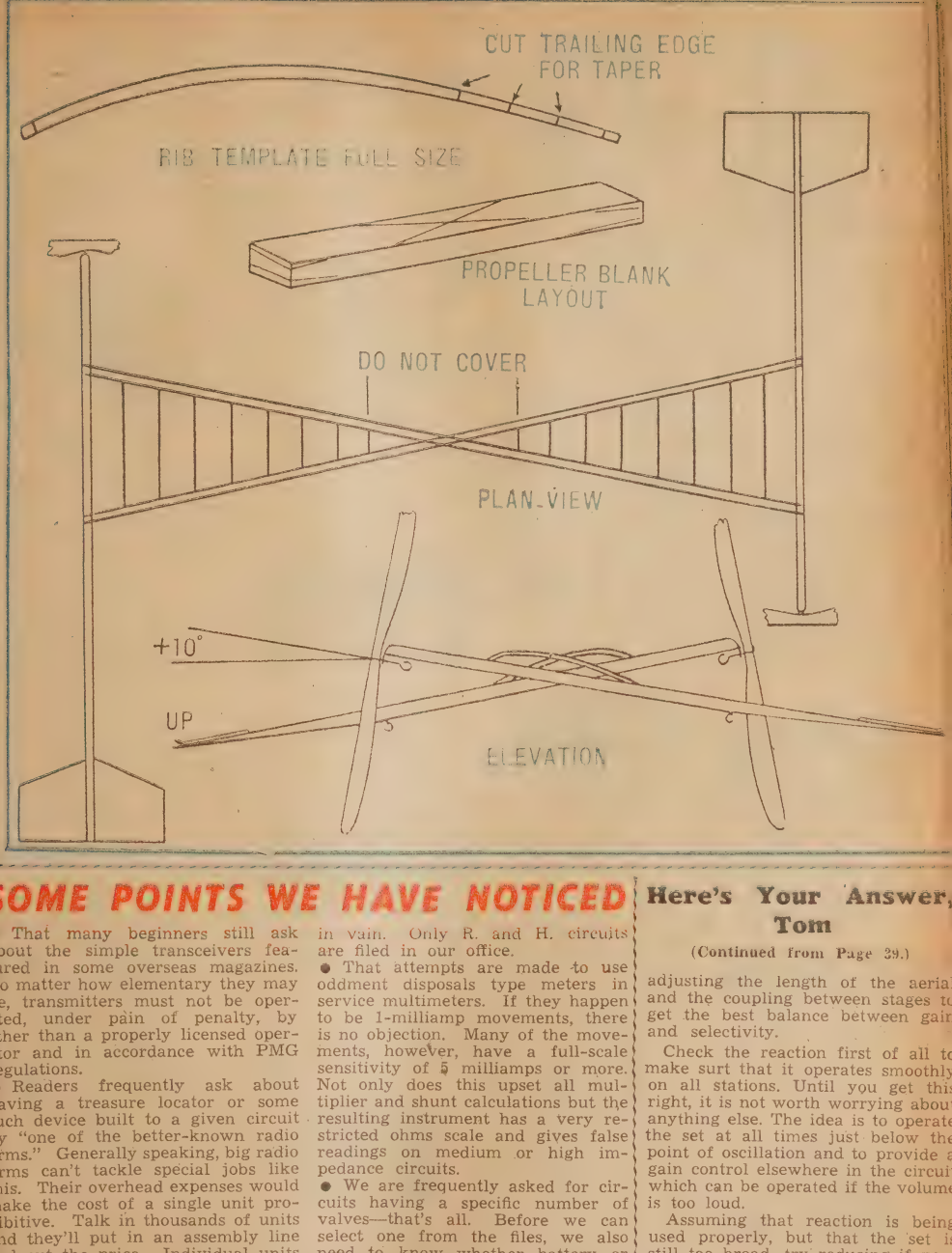
USE THE PLANS

On the other hand, the plans will give you some clues on how to carve them yourself, and if you have the copy of Radio and Hobbies in which we covered the subject fully, you should have no difficulty at all in this direction.

You can now assemble the ship and prepare it for flight. Fit a single loop of ¼in flat or two loops of 1-16 inch square rubber between the propeller and rear hooks and wind each motor approximately 200 turns for your trial flights.

The ship is a little awkward to launch as you have to release both propellers and give it a slight twirl in the direction of rotation at the same time. However, a litle practice should ensure success in this direction, and a smooth vertical climb will result.

There is not a great deal that can or need be done in the way of adjustment, and extremely poor flight characteristics could only be had by very serious departure from the plans. Once you get the knack of launching, wind the motors up to 800 turns and watch the "Willy Willy" whirl into the skies.



SOME POINTS WE HAVE NOTICED

● That many beginners still ask about the simple transceivers featured in some overseas magazines. No matter how elementary they may be, transmitters must not be operated, under pain of penalty, by other than a properly licensed operator and in accordance with PMG regulations.

● Readers frequently ask about having a treasure locator or some such device built to a given circuit by "one of the better-known radio firms." Generally speaking, big radio firms can't tackle special jobs like this. Their overhead expenses would make the cost of a single unit prohibitive. Talk in thousands of units and they'll put in an assembly line and cut the price. Individual units have to be built by individuals!

● Readers often ask us to quote the approximate cost for a kit of parts. We never do it and thereby save ourselves a lot of arguments about price schedules, brands and so on. We supply the list of parts required —you write for a quote from your normal supply house or one of the advertisers in Radio and Hobbies.

● We are frequently asked for circuits of commercial receivers, but in vain. Only R. and H. circuits are filed in our office.

● That attempts are made to use oddment disposals type meters in service multimeters. If they happen to be 1-milliamp movements, there is no objection. Many of the movements, however, have a full-scale sensitivity of 5 milliamps or more. Not only does this upset all multiplier and shunt calculations but the resulting instrument has a very restricted ohms scale and gives false readings on medium or high impedance circuits.

● We are frequently asked for circuits having a specific number of valves—that's all. Before we can select one from the files, we also need to know whether battery or mains operation is desired. It is also helpful to know just what is required of the set so that we can judge whether the choice is likely to be suitable or not.

● Readers occasionally run into trouble with vibrator hash. There is no sure-fire cure in an individual set. It is simply a matter of experimenting with bypass condensers, shielding and earthing until the hash is gradually whittled down.

Here's Your Answer, Tom

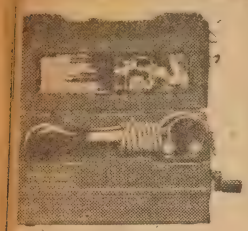
(Continued from Page 39.)

adjusting the length of the aerial and the coupling between stages to get the best balance between gain and selectivity.

Check the reaction first of all to make surt that it operates smoothly on all stations. Until you get this right, it is not worth worrying about anything else. The idea is to operate the set at all times just below the point of oscillation and to provide a gain control elsewhere in the circuit which can be operated if the volume is too loud.

Assuming that reaction is being used properly, but that the set is still too broad, try reducing if possible the number of turns on the aerial coil primary, or on the primary of the RF. coil, if such is used. Alternatively, use a shorter aerial and continue to experiment until you get the best all round results.

If the interference comes mainly from one station, you could try connecting a wave trap in series with the aerial lead in, tuning the wave trap until the strong interfering station gives the least trouble.



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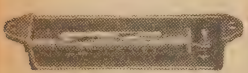

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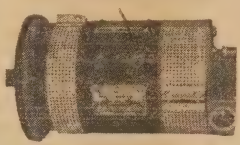

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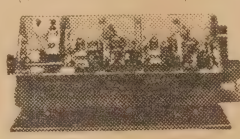

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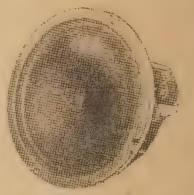

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A Grid-Dip Oscillator

(Continued from Page 33)

To adjust neutralising, remove the HT from the transmitter and couple the unit, operating as a grid-dip oscillator, to the driving tank circuit of the stage being neutralised. Leave the unit set to the bottom of the dip of resonance with this circuit. For each adjustment of the neutralising capacitor/s rotate the stage plate tank capacitor and watch for any reaction on the unit meter reading. Neutralisation is complete when no such reaction is noticed.

The usual method can be employed by using the unit as a tuned RF diode and checking for RF in the plate circuit of the stage being neutralised with the drive on but the HT off.

FIELD STRENGTH

For field strength measurement use the unit as a tuned RF diode. Remember that the meter will read forwards for all RF diode uses. A pick-up aerial of suitable length is attached to the terminal and arranged to be in the same polarisation plane as the aerial or beam being checked or adjusted.

Naturally, the unit will not be as sensitive as when used in other applications in the oscillatory condition but you will become familiar with its pick-up capabilities after a little use.

For absorption frequency meter work, it is again used as an RF diode. All amateurs know the story on the conventional type of absorption meter, most of which use a pea lamp as the indicator. The advantage of this unit for this work is the increased sensitivity afforded by the meter. For example, we coupled the unit to the cathode coil of a receiving type valve used in a tritet crystal oscillator operating on about 250 volts. The meter gave a very definite reading of about 0.2 mA whilst the pea lamp of the conventional type absorption meter did not show a glimmer of light.

STANDING WAVES

The RF diode usage also applies to standing wave measurements on open wire lines. With the aerial fed from the transmitter, or a lower powered driving stage, run the coil of the instrument along the line whilst maintaining uniform coupling thereto. The standing wave ratio is obtained by relating the maximum and minimum meter readings. Naturally, if the line is "flat," the meter reading will be steady. In the same manner, a check can be made for the presence of "antenna currents," i.e., standing waves, on the outer conductor of coaxial cables.

For antenna work, the unit will mainly be used as a grid-dip oscillator. It is interesting to note that a full-wave aerial will be slightly longer than twice the length of a half-wave aerial at the same frequency. This is due to the fact that end effects are found at the ends only of an aerial irrespective of whether it is a half-wave, a full-wave or longer in length. It should

(Continued on Page 97)

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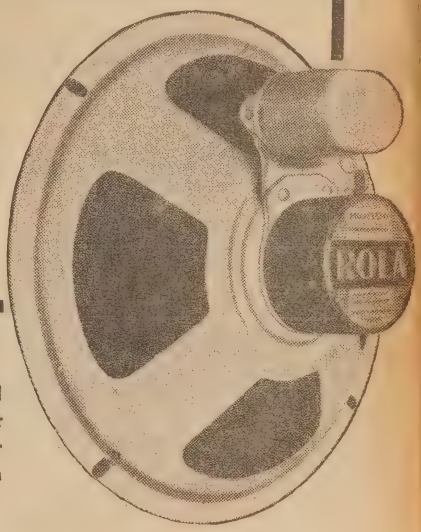

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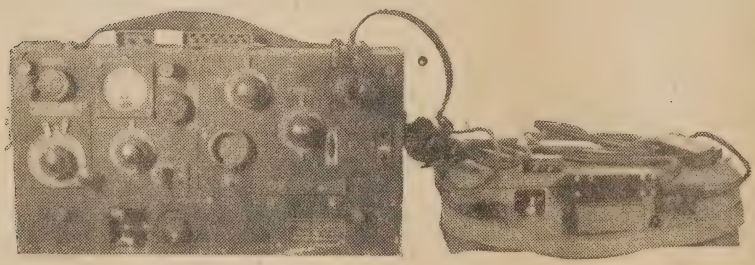

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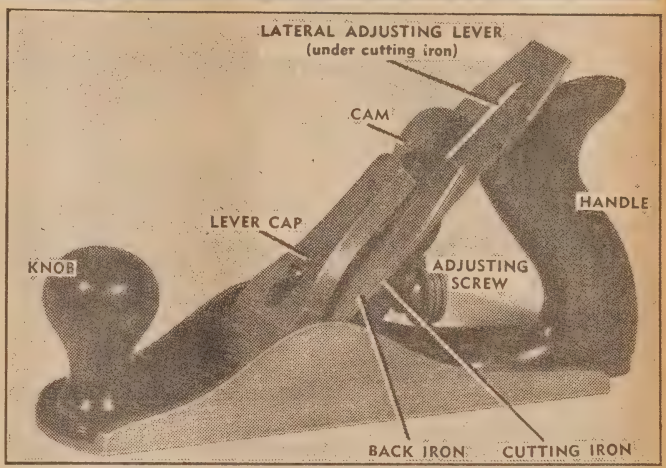
HOW TO USE WOOD-WORKING PLANES



A modern metal Smoothing plane. The Jack and Trying planes are bigger, but have similar parts. Precise mechanical adjustment allows easy and accurate work while the comfortable handles reduce operator fatigue to a minimum.

Although it is one of the most interesting of woodworking tools, the plane is one of the least understood. Many workshop enthusiasts are only vaguely aware of the reasons for the various parts of a plane and why various types of planes are made. In this article, we set out some of the more important points about planes, the understanding of which will lead to easier and better woodworking.

by Maurice Findlay

ONE of the first woodworking tools was the axe. Before better tools were invented, axes were used for felling trees, splitting them into planks and later for smoothing them in a crude way. Later, the need of a better smoothing tool became evident and the adze was developed.

The adze has a handle similar to an axe, but the blade is turned at right angles to the handle and curves in towards the user. It is operated by standing above the plank and chipping in something the same manner as with a garden hoe. Craftsmen developed great skill in the use of the adze and could produce a very smooth finish, considering the simple method. The adze is still in use today for roughing out work, especially on large sections of timber.

For factory production work, speedy and accurate machine planers of various types have been developed in recent years. However, in the home workshop and for small jobs the hand plane is still one of the essential finishing tools.

PRIMITIVE PLANES

The first planes which bear any resemblance to modern planes were made of wood. A hole was cut in the block of wood in such a way that it was possible to insert a blade and secure it with a wedge.

The simplest wooden plane now in use is known as the German Jack. The blade is held in place as described, and a horn shaped handle is attached to the front of the body of the plane. The blade is sharpened with a severe radius and this, in conjunction with the strong handle, allows a very deep cut to be made. The German Jack plane tends to tear the wood and leave a comparatively uneven finish. Its main purpose is for roughing out work where it is desired to remove much wood in as short a time as possible.

The standard modern Jack plane is slightly larger than the German Jack plane, being about 17 inches long and three inches wide. It includes several refinements, which enable it to produce a smooth and accurate finish.

ADJUSTMENT

The blade is held in place with a wooden wedge, but a "back iron" is added. The back iron breaks the shaving as it is being cut, robbing it of its stiffness, and preventing it from tearing out. The closer the back iron is to the cutting edge, the sooner the shaving is broken.

For hard timber, set the back iron about 1-32 inch from the edge and about 1-16th inch for soft timber. The cutting iron is set at a fairly steep angle (about 45 degrees), which also contributes to a good surface on the work.

The cutting iron of a Jack plane, also, is sharpened with a radius, although it is not as severe as the radius used in the case of the German Jack plane. A carpenter would often not include a German Jack plane in his kit of tools, but would rely on the standard Jack plane for all general work.

Two other planes are needed to complete a kit for general woodworking. One is known as a Trying plane, and the other as a Smoothing plane. Both are fitted with back irons, and can produce a smooth, accurate finish.

We will digress for a moment, at this point, to explain why planes of different lengths are needed.

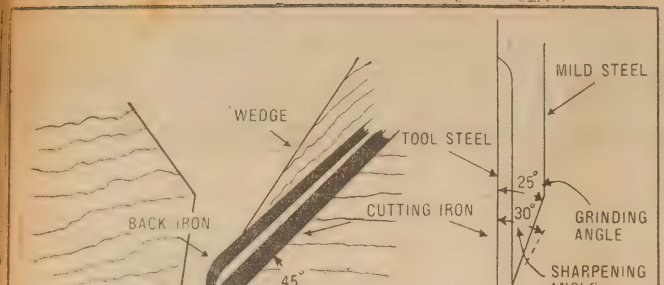
A few moments study of the diagram we have included will show that the plane is not quite perfect in principle. The cutting iron has to project slightly in order to allow it to take a shaving. This means that it is possible for the plane to finish the work slightly curved inwards no matter how accurate the working face. However, the radius of this curve becomes greater as the length of the plane is increased and the cutting iron set to take fine shavings.

The Trying plane is used for accurate work on long pieces of timber, and is about 24 inches long. The cutting iron is sharpened straight across rather than curved as with the Jack planes, since accuracy is the main consideration. The corners of cutting iron are "eased off" to prevent them from "digging in." Since the plane is intended for accurate finishing, the cutting iron is usually set to take a very fine shaving, and the back iron is set very close to the cutting edge.

FINISHING PLANES

The Smoothing plane, as its name suggests, is also used for finishing. It is about eight inches long, and, therefore, can frequently be used in positions where it would be impossible to use a Trying plane.

The blade of a Smoothing plane is sharpened straight across with the corners eased off, in the same way as a Trying plane. If the Smoothing plane is used to finish long pieces **only** a very fine cut, otherwise it will



Cross section of a wooden plane showing cutting iron, back iron and wedge. A metal plane is similar except that mechanical adjustments for setting the blade are available. A thin piece of tool steel is let in and welded to the face of the cutting iron, the body of which is made of mild steel. This allows easy grinding.

detract from the accuracy of the work.

There are cases where it is desirable to plane with a slight curve inwards. A typical example is a desk top which is to be made up of sections glued together. If the adjacent edges of the pieces to be glued are planed with a slight inward curve, it will be possible to hold them in place, for the glue to set, with a single cramp placed in the centre of the job. The natural springiness of the wood allows the entire length of the joint to be in tension, ensuring a good firm job. The curvature should not be very great, and a trying plane is suitable for this particular job in most cases.

The cutting iron of a wooden plane is adjusted by means of a hammer. When it is desired to make the cutting iron project further from the face to take a deeper cut, it is tapped gently with a hammer. Gentle sideways tapping is required to correct a cutting iron which is not level with respect to the face.

To remove the cutting iron or to set the plane for a finer cut, tap the front of the plane on top. Often a piece of special wood or leather is let into the main body of the plane so that this operation can be carried out without damage. Removal of the blade can also be effected by tapping the plane on the heel.

After setting the plane for a finer cut always tap the wedge to ensure that it is firm.

All the planes we have mentioned, except the German Jack, may now be obtained in either cast iron or aluminium and with mechanical adjustments. These planes possess many advantages. They retain their accuracy over a longer period than their wooden counterparts, and the mechanical adjustment for cutter alignment and depth of cut makes them much easier to handle. They are fitted with a comfortable handle at either end and can be used for long periods without tiring the operator.

OIL PAD

One disadvantage of metal planes is that they tend to drag after a few moments use. This is especially noticeable with soft timbers. The trouble may be prevented by occasionally wiping the fore part of the plane with an oily pad. You can easily make up a pad by cutting out a strip of felt and winding it into a coil to fit into a tobacco tin. The tin can be permanently attached to the bench, where it is available for use at any time.

Care should be taken not to allow the cutting iron of a plane to rest on the bench where it may come in contact with grit, nails, screws, &c. It is a good idea to nail a thin strip of wood to a convenient part of the bench and rest the fore part of the plane on this. Never allow a plane, especially a metal plane, to drop. The adjustments are likely to be upset and, in addition, the metal plane is very likely to break.

The sharpening of a plane is an operation with which every woodworking hobbyist should be familiar. The cutting iron is made up of a piece of mild steel to which is welded a piece of tool steel. Thus, the iron is able to hold its edge over an extended period, given reasonable treatment, and is at the same time easy to grind.

GRINDING

The correct grinding angle is about 25 degrees. When regrinding a cutting iron, make sure the edge is straight if it is for a Smoothing or Trying plane, or slightly rounded for a Jack plane. Take care to get the edge of the iron even. It is almost impossible to do this with a hand grinding wheel if you have to turn it yourself. Wait until you can get an assistant or have access to a power-driven wheel.

The sharpening is carried out with a medium or fine oil stone. The correct sharpening angle is 30 degrees. Take long, even strokes and avoid rocking. Having completed the sharpening at the correct angle, turn the cutting iron over and rub it flat against the stone once or twice to

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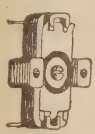

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How To Use Wood-Working Planes

emove any burr. The final keen dge may be imparted to the blade y stropping it on the hand. Take are not to cut yourself!

Complete the job by screwing the ack iron in place and adjusting the lade in position.

There are literally dozens of pecial-purpose planes available for utting special shapes—plough, filis-er, rebate, bead, ovolo are the names f some of the more common types. Their job is to make specially-shaped uts for mouldings, &c. Except in ery special cases, it is hardly worth vhile buying these planes for home vorkshop use.

The Block plane is a small elemen-ary plane which is useful in certain ases where physical size prevents he use of a larger plane. The blade s set at a low angle which allows : to cut very easily, but, because of his and the absence of a back iron, : is necessary to go over the work vith glass paper to produce a fine nish.

If most of the projects you anti-ipate handling are fairly small, and ou only wish to buy one plane, a ietal Smoothing plane is a good noice. Sharpen the cutting iron with very slight radius in this case. If, owever, you think the smoothing lane is too small, buy a Jack plane nd sharpen the cutting-iron in the ame way. A Trying plane is only eally necessary for large jobs such as oors and door frames, table-tops, :c., which have to be really accurate.

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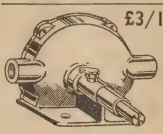

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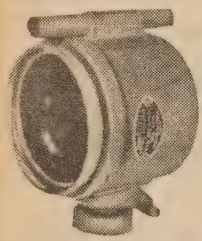

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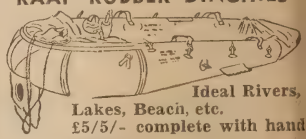

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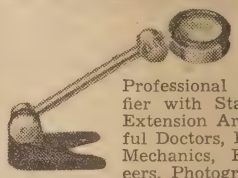

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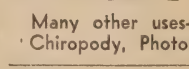

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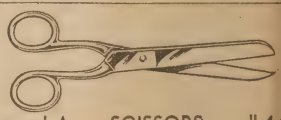

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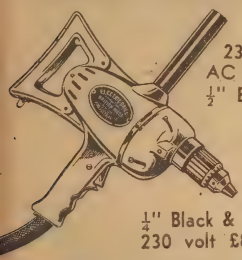

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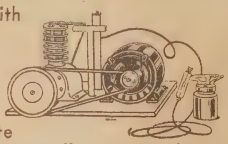

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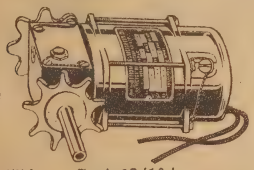

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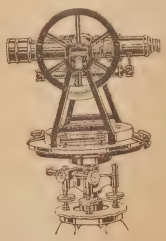

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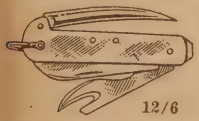

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The pick-up coil is of high impedance, being 1,300 Ohms at 1,000 CPS. The output direct from pick-up is .1 volt from a standard recording of 12 db up on the zero reference level 1 cm/sec. RMS velocity.
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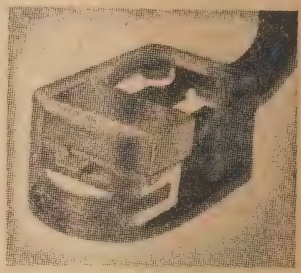

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Machines guided by Robot Brains

(Continued from Page 7)

library card, they can do in two minutes what would take human librarians a whole day.

When the Navy wanted to find out how to do a better job of teaching its specialists, it built a robot scorekeeper in a classroom at the Pennsylvania State College. At the touch of a switch the robot tabulates answers and makes an instantaneous permanent record of students' responses to different teaching methods. Automatically printed statistics show whether such variations as color film, sound tracks or music help to speed learning time.

Traffic control is fast becoming robotised. In San Diega, Calif., for example, electronic plates buried in a main highway count passing cars and synchronise lights to let autos go faster or slower, according to the density of traffic. The system has already cut accidents by 20 per cent.

STREET LIGHTING

The world's first robot street-lighting set-up was recently installed in New Milford, Conn. Electronic eyes react to changes in natural light —a sudden thunderstorm, early twilight, a rainy morning—and turn on street lamps according to need.

Traffic engineers are excited about a new robot eye which, mounted on a car's bumpers, "buzzes" the driver if the auto is over the centre line, or if he is getting too close to another car.

Elevator traffic is another field where robot-system control is growing. Westinghouse's new Selectomatic system sorts signals from waiting passengers and sets up a pattern of "commands" for starting, stopping, accelerating or braking. Each elevator can almost sense a waiting rider. During peak periods the cars automatically parcel out among themselves a co-ordinated system of equally swift service for all floors.

Something still for the future is voice-controlled elevators. A model recently demonstrated in bi-lingual Montreal rose at the sound of "going up" or "monter" (its French equivalent); it came down when the voice said "descendre," or "down please."

COMPLEX PROBLEMS

Work horses of the robot world are the electronic brains. Their ability to solve infinitely complex problems 12,000 times faster than any human genius makes them essential tools of science. With vacuum tubes for grey cells, the wizard-like brains can do such things as multiply hundreds of 10-digit numbers in a thousandth of a second. One Government bureau had to multiply 100,000 pairs of figures each year and add up the results. It took 12 days for the staff to do the job. A robot does it in 10 minutes.

The brains can trace the movement of the universe, work out gambling odds, or add two and two. They only make an error when a vacuum tube burns out. Even then the brain knows what has happened and flashes a warning signal.

International Business Machine's new "selective sequence calculator" is almost frighteningly superhuman: it not only "reads" its problems and instructions, but knows when and how to use such mathematical short cuts as logarithm tables which it has stored in its electronic memory.

Will mankind ultimately create such efficient robots that they will revolt and become masters instead of servants? Dr. Norbert Wiener, of Massachusetts Institute of Technology, founder of cybernetics—the science of the relationship of human and mechanical brains—doesn't think so.

But robot brains, says Wiener, will not solve the major human problem the worship of power with no idea of where that power is leading.

"We have got to develop our characters or get off the earth," he says. "Mechanical brains can give us logic and mathematics. But men need more than that. If we have no principles, the answers of the robots despite their magic, will be useless to us."

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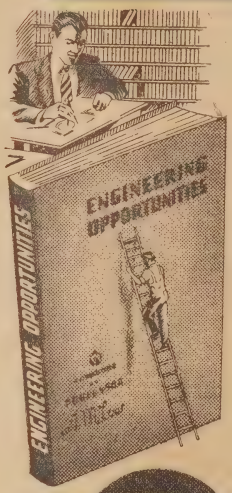

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SHORT WAVE NOTES BY RAY SIMPSON

CLANDESTINE SHORT WAVE STATIONS

NEW FREQUENCY ALLOCATIONS

The value of radio as a means of expressing opinion was used to the full during the last war and for that matter is still one of the chief means of reaching the population. As distinct from the official Government stations of the various countries, there has sprung up a large number of clandestine stations to further the cause of different political groups. These stations are confined in the main to Europe, where political activity is always most active.

NATURALLY it is always rather difficult to give the location of these stations as quite often they give misleading information in their announcements in order to prevent the location of the transmitter being discovered by the Government or opposing parties as if it were discovered it would inevitably lead to confiscation and even bloodshed.

Some of these stations have been heard in Australia, notably "Espana Independiente," but there are a number of others which may have been heard but not identified. The following list may be of use in clearing up a few which possibly have previously been listed as mysteries.

"Free Greece" 6.122 mc, 6.71 mc, 9.455 mc "Free Yugoslavia" 6.42 mc, 8.845 mc "Revolutionary Yugoslav Emigres" 6.105 mc, 6.9 mc. "Clandestine Yugoslav (Anti-Tito)" 6.7 mc. "Fighting Poland" 9.85 mc, 15.53 mc. "Espana Independiente" 7.63 mc, 11.62 mc, 14.66 mc. "Venezia Giulia" Italy, 6.235 mc, 6.4 mc. "Radio Emilia Lavoratori Libera" 6.45 mc. "Basque Freedom" 6.095 mc.

It is of course impossible to send reports to these stations as no addresses are known. Their broadcasts are primarily intended for their own sympathisers or followers and they would in fact not be interested in reports from listeners in other countries.

We have been trying to find out something official regarding the new frequency allocations which we understand were to come into effect around June of this year. Nothing definite is known as yet and it is doubtful if final arrangements have been made for the changeover.

There is a possibility that some of the short wave bands will be extended but we think the main idea is to so arrange the allocations that the least interference will be caused by stations who have to share channels. By careful choice of the station location and its operating schedule, it is possible to ensure that one will be off the air while the other is broadcasting.

What we would like to see is the abandonment of split frequencies, that is, have all stations on even multiples of five kilocycles i.e., 9650 kc, 9655 kc, 9660 kc with no other stations squeezed in on odd frequencies such as 9653 kc, 9657 kc, &c. Admittedly with the selectivity obtainable on the short wave frequencies this may be considered a waste of spectrum. However, we still feel that when two powerful transmitters are only 5 kc apart it is only making matters worse by inserting others in between.

No doubt this has all been considered at the Atlantic City Convention and we must now just wait and see in the hope that reception will be easier as a result of their deliberations.

TIME TABLE FOR MORESBY

In the November issue we published the transmission hours of the ABC's short wave stations but unfortunately there were a few mistakes as regards the Port Moresby stations VLT5 and VLT7.

We are indebted to Mr. A. E. Finch, of the PMG Department, Port Moresby, who kindly sent along the correct schedule for this station. He pointed out that since the station opened on June 28, 1948, its schedule has always been as follows:

VLT5, 7.28 mc: Monday to Friday, 6.45 am to 8.45 am, 6.15 pm to 10.45 pm Saturday: 6.45 am to 8.30 am. 6.15 pm to 11.0 pm. Sunday: 7.45 am to 11.0 am. 6.15 pm to 10.0 pm.

VLT7, 9.52 mc: Monday to Friday: 12.0 noon to 1.45 pm. 4 pm to 6 pm. Saturday: 12.0 noon to 6.0 pm. Sunday: 12.0 noon to 2.0 pm. 4.0 pm to 6.0 pm.

The medium wave station 9PA observes the same hours but does not close while VLT is changing frequency between 6.0 pm and 6.15 pm.

Many thanks Mr. Finch for the above information and I know you will be pleased to know that both VLT5 and VLT7 are both being heard at very great strength in Sydney especially the former which is really fine around 7.0 am.

SOME VERIFICATIONS OF THE MONTH

CS2MQ, PORTUGAL. It seems quite some time since we had word of a verification from Portugal, though they may have been sending them out without our knowing. Their latest one takes the form of a double folded card with a crest on the front and the words Emissora Nacional de Radiodifusao and inside there is a very attractive photograph of an elaborate gateway with a statue of D.Jose I.

There is also an insert which gives verification details in Portuguese, English and French confirming reception of CS2MQ on 15.16 mc. Incidentally it may be of interest to know that CS2MQ has an alternate frequency in this band on 15.145 mc.

LARISSA, GREECE. The Armed Forces (Central Greece) Radio Broadcasting Station in Larissa is now sending out a very nice verification card showing on the left a map of Greece with the Greek flag flying on a mast in the centre of a red target superimposed on the map. To the right are the verification details which state that the station operates on a frequency of 6.745 mc with a power of 500 watts from a half wave delta matched radiator.

Times on the air are from 3.0 pm to 5.0 pm; 8.0 pm to 11.0 pm; and 2.0 am to 6.45 am. The station director says there is an English session on Fridays only at 6.30 am and that the station is anxious to have further reports from Australia.

BED4, TAIWAN. The Voice of Free China are now verifying listeners' reports with a letter from Mr. Chang Shui-yu. Head of the Audience Service Section. In his letter he verified reception of BED4 on 11.8 mc and also for 11.735 mc and stated that their station was using BED3 on 15.235 mc beamed to the USA and on the air from 2.0 pm to 4.0 pm, and BED4 on 11.8 mc operating from 8.0 pm to 2.30 am.

This latter station however is not now on the air and has been replaced by the outlet on 7.15 mc as mentioned in the New Station paragraph. With hostilities flaring up again on the nearby island of Hainan, it is doubtful as to how much longer the Nationalist authorities will be able to transmit from Taiwan.

HE18, SWITZERLAND. Some months ago we noticed one night that when the Swiss station opened up, instead of being on HER7 17.785 mc as announced, they were actually around 17.795 mc or slightly less, which would of course be HE18. We reported this to the station and the station director sent a very nice reply confirming that they had not opened on the correct frequency but were actually on 17.7918 mc.

The reason was as follows he said: "On the afternoon in question the undersigned had to show the station to a few visitors from abroad. There are only two technicians on duty at this time, and the one who was responsible for 17.784 mc was busy giving explanations to our visitors. So it happened he forgot to control the frequency he was using. Upon an admonition from an engineer, everything was corrected. It was most interesting that you detected the mistake and went on listening." It was very gratifying to receive such a nice letter explaining this mistake as so often a station will still insist that it is transmitting on a certain frequency when it is quite evident that they are not on their assigned channel.

SHORT Wave Notes for the May issue are due on April 8. For the June issue they are due on May 6. Please send them direct to Mr. Ray Simpson, 80 Wilga Street, Concord, NSW.

ISRAEL. The Israel Broadcasting Service broadcast a special fifteen minute programme over "Kol Ysrael" on 9.0 mc on March 11 at 7.30 am and again on the same day at 2.0 pm. This programme was for the benefit of the International Shortwave Club members and was given by the well known DXer, Herbert Blumman. The station authorities would appreciate any reports of reception on these programmes and ask that they be addressed to the Israel Broadcasting Service, PO Box 17, Hakirya, Israel. While speaking of this station, we notice that it can still be heard on most mornings around 6.30 thansmitting on 6.83 mc but no English has been heard at that particular time though it may be in use earlier in the session.

YUGOSLAVIA. We learn from the Universalite that Radio Belgrade is soon to have a new transmitter which will be used to direct programmes to the USA. At the present time quite good signals can be heard from YUC on 9.505 kc in the late afternoon when news in English is given at 5.0, usually by a lady. Their other station, YUA can also be heard in the early mornings on 6.1 mc but not nearly as well as YUC in the afternoon.

A summary of African Stations

At this time of the year reception of the African short wave stations improves somewhat and although they are never heard at the same strength as the other continents, they are sufficiently loud to enable identification.

Here is a short summary of what can be heard at the present time, admittedly most of them at a rather inconvenient hour but this of course is unavoidable due to the difference in time relationship.

MOZAMBIQUE. We will first of all deal with Mozambique as it is the m consistently heard African both now and at other times of the year. Thanks to the DX session from Radio Australia we will first of all give their current schedule:

CR7AA, 6.137 mc: 2.0 pm to 5.0 pm, Monday to Saturday. English. CR7BU, 4.93 mc: 2.0 pm to 5.0 pm, Monday to Saturday. English. CR7, 9.766 mc: 5.0 pm to 3.0 am daily. English. CR7AA, 6.137 mc: 5.0 pm to 3.0 am. Daily. English. CR7BU 4.932 mc: 3.0 am to 7.0 am, daily. English. CR7AB, 3.490 mc: 3.0 am to 7.0, daily. English CR7BJ, 9.766 mc: Tests only at 2.0 pm. English. CR7BE, 9.671 mc: 3.0 pm to 4.0 pm, 7.30 pm to 9.30 pm, daily. Portuguese. CR7BE, 9.671 mc: 7.0 pm to 9.0 pm, Sunday. Portuguese CR7BV, 4.819 mc: 2.0 am to 6.0 am, daily. Portuguese. CR7BG, 15.196 mc: 6.0 am to 6.30 am, Friday only. Portuguese.

The above schedule does not show the period around midnight when CR7BJ on 9.776 mc is heard at very good strength. For morning reception, tune to CR7BU on 4.932 mc which is very fine at 6.0 am.

SOUTH AFRICA. The South African Broadcasting Corporation station at Johannesburg which operates on 9.87 mc can now be heard at quite fair strength from as early as midnight and improves slightly towards 2.0 am. Their other outlet on 9.523 mc can also sometimes be heard from just after 2.0 am though not as loud as 9.87 mc. The latter station transmit in English while 9.523 mc is in Afrikaans. The Johannesburg station on 4.895 mc is audible till closing at 7.05 am and Capetown on 5.88 mc can sometimes be heard till closing at the same time.

FRENCH EQUATORIAL AFRICA. Here is another country which is heard at good strength in Eastern Australia especially the outlet on 11.97 mc which comes in nicely in the afternoons and also from around 6.0 am. Two other good outlets in the mornings are 9.44 mc and 9.990 mc both of which give news in English at 6.45 am as also does 11.97 mc.

BELGIAN CONGO. All listeners have heard OTC2 on 9.768 mc we think as it comes in very nicely from 6.0 am. OTH on 9.21 mc is sometimes audible a little earlier but OTM2 on 9.4 mc is always there till as late as 7.0 am and on a few mornings this last week we have also heard their experimental transmissions on OTM3 on 11.645 mc.

MAURITIUS. The Port Louis Station in this British colony can now easily be logged when they open at 12.30 am on 15.06 mc. Look for them just slightly lower in frequency than London on GWC 15.07 mc. When their carrier comes on the air it is very strong but the actual speech and music is very much weaker. Most of the announcements are in French though English can be heard at times.

MADAGASCAR. This French island puts in a good signal from Radio Tananarive on 7.38 mc till closing at 6.0 am and if you care to listen around 2.30 am there is also their transmission on 6.065 mc and also on 9.695 mc though the former is much the better.

AZORES. We will include the Portuguese colony of Azores under Africa as their station CS9MB on 11.09 mc is quite legitimately included as an African station. It can be heard every morning from 6.0 am and possibly earlier and in fact is still audible just before 7.0 am. We have not checked to see if they are using their other transmitter on 4.845 mc but when in use, it, too, was heard quite well.

NEW STATION LOGGINGS

Call	KC	Metres	Location	Time Heard
YDH2	3945	76.05	Semerang, Java	10.30 pm
Mecca	3950	75.95	Mecca, Saudi-Arabia	4.00 am
Mecca	5990	50.08	Mecca, Saudi-Arabia	4.00 am
BED2	7150	41.96	Taipeh, Taiwan	9.15 pm
Singapore	7250	41.38	Singapore, Malaya	10.00 pm
Vietnam	7270	41.26	Vietnam, Indo-China	9.15 pm
WABC	9650	31.09	New York, NY, USA	8.00 am
Mecca	9650	31.09	Mecca, Saudi-Arabia	4.00 am
ZJM8	9665	31.04	Limassol, Cyprus	4.00 pm
YDS	9680	30.99	Menado, Celebes	9.00 pm
F.B.S.	9925	30.23	Malta	4.30 pm
Tangier	11710	25.62	Tangiers, North Africa	5.00 am
Mecca	11750	25.53	Mecca, Saudi-Arabia	4.00 am
VLA8	11810	25.40	Shepparton, Vic.	1.00 am
KCBF	15310	19.60	Delano, Cal., USA	6.00 pm
ZUD32	17390	17.25	Pretoria, South Africa	11.30 pm

NEW OF SOME NEW CALL-SIGNS

SAUDI ARABIA. Here is a new country for the majority of listeners we imagine and fortunately it can be heard without much difficulty though you do have to listen around 4.0 am which is not the most convenient hour. Art Cushen was the first to bring this station to our notice, telling us that he had heard them on 3.95 mc, from 4.0 am till 4.15 am when they moved to 3.96 mc and also from a rhombic to a doublet antenna.

They were also heard on 5.99 mc (then moved to 6.1 mc and then 6.175 mc) 9.65 mc, 11.75 mc (then moved to 11.85 mc and later 11.95 mc). During these tests an American announcer was on duty. Since receiving Art's letter we have logged them in Sydney on both 6.175 mc and also 9.65 mc, the latter being the loudest signal.

MALAYA. Radio Malaya are evidently extending their activities as they have now been heard using an additional frequency in the 41 metre band, namely 7.25 mc where they can be heard nightly from coming on the air at 8.30.

The first hour or so of their programme is in Chinese and Malay, being their Blue Network programme in parallel with 4.78 mc but later in the night they change over to English which of course is much easier for listeners in Australia.

Strength of signal is not particularly good in Sydney and not nearly as strong as their other outlet of 7.2 mc but except when the noise level is high, sufficient can be obtained to make out a worthwhile report. This channel was used by Singapore years before the war.

SOUTH AFRICA. Many listeners who previously had not been able to log a South African station will doubtless have heard one or other of the PMG stations which have been rebroadcasting the cricket commentaries for the Australian Broadcasting Commission. Various stations and frequencies have been used and the latest one in use during the 5th Test match was ZUD32 on 17.39 mc.

This station could be heard at reasonable strength from just before 11.30 pm till leaving the air a few minutes after midnight. Actually at our location, ZUD32 was the best of all the stations previously heard such as ZUD on 17.748 mc, ZUD24 on 8.695 mc, ZUD28 on 13.186 mc and ZUD31 on 17.226 mc. The PMG in Pretoria has verified all these stations and returned reply coupons which were sent with the reports.

TANGIER. The Voice of America relay station in Tangiers is really excellent at 6.30 am and can be followed till as late as 8.0 am on a good morning when the noise level is not too high. English is used in the latter portion of their programme.

MISCELLANEOUS. Among the other Africans being heard at this time are VQG1 in Nairobi which is quite enjoyable around 4.0 am if you care to get up at that time. Ethiopia has been heard on 15.055 mc from station ETAA from around 1.0 am and at other times has also been logged on 9.62 mc. Radio Maroc, CNR3 on 6.005 mc has improved greatly recently and can easily be heard around 5.30 pm. Angola has quite a few stations on the air but the only really regular is CR6RN on 9.475 mc still being heard daily till 7.0 am, while of course there is also the new one, CR6RO on 7.59 mc which closes at 6.0 am. Radio Omdurman on 9.75 mc can sometimes be heard in the afternoons at 3.0 pm but is very difficult to understand.

INDONESIA: There must be many Indonesian stations which have not as yet been listed in these columns as new stations though probably they have all been heard at one time or another by different listeners. Among the new ones noticed at our location are YDH2 on 3.945 mc located in Semerang. It can be heard quite well in Sydney around 10.0 pm and later.

The Menado station YDS which was previously heard around 9.725 mc has now been heard using 9.68 mc where it is more free from interference. The best time to hear it is from just before 9.0 pm till about 9.30 pm. On the air they announce as "Hier is Menado, Radio Indonesia" and then give news in Dutch. In a future issue we hope to give a complete list of the Indonesian stations.

CYPRUS. The Near East Arab Broadcasting Station has been heard from their two transmitters ZJM5 on 6.17 mc and also from ZJM8 on 9.665 mc, the latter being much the louder. The best time to log either of these two stations is from about 3.45 pm and they can then be followed until they leave the air at 4.30 pm or a few minutes later.

The programme is in Arabic but by careful listening you can pick out a few words of the news. It is also reported in Sweden Calling DXers that ZJM3 has also been logged in Europe using their 4.06 mc though this station is listed as being on 3.32 mc. The time of this reported reception of ZJM3 was around 3.0 am so next time you are up at this hour, have a listen and you may hear them.

MISCELLANEOUS. The Forces Broadcasting Station in Malta has been logged on yet another frequency, this time 9.925 mc where it can be heard in the late afternoons but not as good as on 7.27 mc. Another Radio Australia outlet has been heard, this one being VLA8 on 11.81 mc which comes on the air at 1.0 am with programme for North America. The Voice of Vietnam is coming in with a very strong signal on 7.27 mc and the news in English is easily followed at 9.15 pm. The Voice of America relay over Tangiers is very loud on 11.71 mc till leaving the air at 6.0 am. The Voice of Free China on BED2 is now heard well on 7.15 mc with news in English at 9.15 pm and lastly there is WABC on 9.65 mc with programme in English at 8.15 am, and KCBF on 15.31 mc with A.F.R.S. programmes at 6.0 pm.

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THE CALSTAN '529'

THE HAM BANDS WITH BILL MOORE

Amateur Radio again demonstrates the value of the hobby as a National asset in a new field, which has been arranged by the Radio Society of Great Britain in conjunction with the Air Ministry and the GPO in the British Isles.

SOME months ago an appeal was made through the BBC for British amateurs to listen out for signals from an RAF aircraft presumed to have forced landed. As no details of possible frequencies in use or call sign were given, the appeal failed in its objective.

RSGB ACTION

Following this incident the RSGB took up the matter of what assistance could be rendered the RAF by radio amateurs in cases of emergency such as the above.

Officers of the society later met with Air Ministry officials, and the subject of aircraft distress calls were discussed. It is the normal practice for aircraft in distress to communicate with the ground station with which it is normally working. In the event that communication cannot be established on this channel, a change is made to recognised aircraft distress frequencies.

These are normally 6500 kc/s by day and 3805 kc/s by night. It was pointed out that if such calls were made on amateur bands, it would be certain that they would immediately be picked up.

At all times, day and night, amateurs are active, and the bands are continuously monitored. This fact was pointed out to the Air Ministry, and as a result of the conference the RSGB announced that, in the future, aircraft that have force-landed will, after all normal distress procedure has failed, send distress calls in the 7 mc band within the limits 7000-7150 kc/s.

Amateurs in Great Britain have received instruction in the manner such calls will be made and methods of replying.

The above scheme is an important move in fully using the services of amateur radio. Since the opening of higher frequencies for amateur work, some incredible feats have been performed in the way of relief work over long distances.

TWO INSTANCES

Two cases immediately come to mind. Firstly, XFB8AB, of Madagascar, left for Ile de Paul on a trawler which was investigating lobster fishing on the island. Some months later W7DWG, while tuning the 7 mc, picked up a QST from XFB8AB stating the vessel had run out of coal, due to bad weather.

On the following day XFB8AB was contacted by W6MUS, the first communication made with the trawler for 33 days. The plight of the vessel was reported by the Navy Department to the French authorities, and a relief ship was despatched—rescue at 11,000 miles by amateur radio.

Secondly, late last year ZS9F, who works on a timber concession in Bechuanaland, used amateur radio to obtain medical assistance for some natives injured by a leopard. The concession during the wet season is practically isolated by road, and it was necessary to obtain relief by air. ZS9F's direct calls to Northern Rhodesia failed, but he contacted F8SK in France, who in turn raised an amateur station in Dakar. It was not until W10NK broke in and retransmitted the message to Southern Rhodesia that relief was obtained. The messages certainly went a long round to obtain an air ambulance from a few hundred miles distant.

There are many other cases on record, and undoubtedly, if and when aircraft use the 7 mc band for distress calls, they will be picked at distances such as the above.

NORTH COAST ZONE CONVENTION

An extremely comprehensive programme has been arranged by the organisers for those attending the WIA North Coast Zone Convention to be held at Urunga over Easter.

The detailed programme is as follows: Saturday, April 8, 2 pm: Assembly of all amateurs at VK2XO's shack (between the traffic and railway bridges at Urunga), for the purpose of registration and the issuing of identification discs.

5 to 6 pm: Social gathering at VK2XO's shack for meeting all those present and the disposal of an "18 watter."

8 pm onwards: Urunga Recreation Reserve for lectures by prominent amateurs. The following are the subjects:—

VK2ADE: "Conversion of the 522 receiver for use on 6 and 2 metres."

VK2EA: "Super Modulation."

VK2MM: "Metres, their uses and abuses."

VK2ADT: "Turret coil switching in receivers."

A dance and card evening have been arranged for those so inclined.

A fishing competition, running from 8 pm Saturday until 6 pm Sunday, has been organised, and a special prize will be presented to the amateur producing the biggest fish.

Sunday, April 9, 9 am: Yabbie-catching competition (world championship), Urunga Lake. The Australian champion, Cess Hardman, VK2KR, will defend his title.

10 am to noon: Bus tour of the Bellingen River Valley.

2 pm: Assembly at the School of Arts for the start of the 144 mc "hidden transmitter" search for the WIA Cup.

5.30 pm: Reassemble for general meeting and community singing.

7.30 pm: School of Arts Hall. Official welcome to visiting amateurs to the convention by the president of the Urunga Progress Association, Mr Chas Eddy.

Film show presented by Ted Hamey.

Demonstration by the four-year-old "wonder boy" of radio.

Lecture by the WIA guest lecturer, Joe Reed, VK2JR, his subject being, "Model radiator investigation on low angle radiation."

Presentation of the prizes won in the various competitions.

Monday, April 10, 10 am to noon: Assembly at VK2XO's shack for competitions and discussions.

This is the final session of the convention.

It is anticipated that at least 100 amateurs will attend the convention, including visitors from Queensland and Victoria. Those attending will be housed at the hotel and in private homes in the town. Extensive portable activity is anticipated, and quite a number are flying to the show.

Secretary Maurrie Butler, VK2AAN, and assistant secretary Dave Evans, VK2AYE, will officially represent the NSW Division of the WIA at the convention.

UHF CONTEST

The results of the Australasian UHF contest run by the NSW WIA UHF Section are to hand. Extremely well supported, and logs were received from all Australian States and New Zealand districts—74 logs altogether. It looks like an annual affair from now on, to be run during the peak of the UHF season in the summer.

Winners are as follows:—

Open Section: First, VK4BT, 3887 points; second, VK2ABC, 3741; third, VK6WG 2955.

DXCC

Considerable controversy has arisen in DX circles on the subject of DXCC awards and the issuing of stickers to be attached to the certificate denoting the numbers of QSL cards in excess of the century that have been submitted.

A number of amateurs think that the certificate should be complete when the century is reached. There are many aspects of the case, and it is considered by those that believe in the curtailing of the award that such action would assist those who are still struggling to reach the century. They believe that these amateurs would no longer be competing with VK2000, who is looking for a confirmation from his 297th country.

RARE DX

Rare DX cards are getting scarce these days, and the old accepting practice of exchanging cards is fading.

Stations which in the past were renowned for years for their QSL policy no longer send QSL's. Whether the reason be financial, lack of cards, or lack of time to attend to the clerical side of the business is not known, but all points could contribute to the problem.

Amateurs in the last couple of years who have been trying to obtain a DXCC are having great trouble in collecting the verifications. Those amateurs who started early were fortunate, and if we could help those working toward the award it would be a good idea.

If the DXCC award was terminated at 100 countries, perhaps it would assist. You work six continents for a WAC, 40 zones for a WAZ, and then finish; you do not continue on. As mentioned previously, perhaps you would not be competing with VK2000 for the elusive ones.

There is only one snag to the above reasoning. DX-chasing is a disease, and whether lack of official recognition and stickers would stop VK2000 from continuing on, is purely conjecture. The betting is that the only way to stop the race is to have no further countries to contact!

WIA NEWS

Results are to hand for the "mistakes" in the circuit competition held at the WIA Woy Woy Field Day. Winner was Maurice Brown, VK2OR, who receives a Command transmitter donated by Electronic Equipment Co. Second, Harry Hawkins, VK2YL, 144 mc tuning unit donated by John Martin Pty., Ltd. Third, Bob Young, VK2ARN, Eddystone condenser, donated by Trevor Evans, VK2AWS.

March UHF Section meeting in NSW saw Jeff Stewart, VK2OX, lecture on "Magnetic tape recording technique." He traced the history of tape recording and the various methods in use today.

A novel feature was the fact that half the lecture had previously been placed on the tape.

Next UHF meeting, to be held at Science House on April 14, will see well-known lecturer Angus Robertson, of DCA, speak on "VHF navigational equipment."

Harold Mansfield, VK2LV, is the new secretary of the Hunter Valley branch of the WIA.

The Gladesville Radio Club has been very active in the UHF field, and have attempted to put signals between Mt. Kurrajong, in the Blue Mountains, to Mt. Kiera, near Wollongong on the 576 mc band. VK2ALU from Kurrajong was using a double-conversion superhet with a "lighthouse" tube as an RF stage.

Officers re-elected for the year were: President, C. Fryar, VK2NF; secretary, K. Andrew, VK2ATK; treasurer, L. Pattison, VK2ALU; publicity officer, Ken Whitmore.

DX AND PERSONAL

Amateurs who have listened to the special "Voice of America" broadcasts on amateur radio affairs will be interested to learn that these sessions are now being rebroadcast by the BBC on the normal broadcast band, as well as on the BBC shortwave service.

One rebroadcast being made on the high end of our 7 mc band.

Trevor Evans, VK2NS, is the third NSW station to reach the 200 countries mark postwar. Trevor stopped on 198 for some time, but AC3SQ and UO5KAA came along to complete the double century.

The first to reach 200 was Gordon Cole, VK2DI. Arthur Stowar, VK2ACX, third. At the moment VK2ACX is slightly ahead in the total countries contacted.

Although not arranged by amateur radio, amateurs in Sydney and Melbourne were responsible for the safe transit of FK8AC's daughter from Noumea to a school in Melbourne. Felix, FK8AC, was quite happy to leave all arrangements to the gang, even to the extent of selecting the school.

The only problem was that the daughter spoke French, but the sign language covered all emergencies. Those responsible for the deed were VK3RJ, VK2YC, VK2HI.

AC4NC and AC4RF, on telephony on 14,140 kc/s, approximately, created quite a flutter among the DX gang. Zone 23 is no longer the exclusive spot it was when Reg Fox, AC4YN, was the only station active. AC3SQ in Sikkim has also been active.

ZS7C Swaziland, 14,015 kc/s, has been heard about 0200 hrs EAST, but, as expected, he was receiving plenty of attention from W stations.

The NZART, at their June convention last year, decided to set aside 3500-3550 kc/s for CW operation exclusively. Due to the non-observance of the agreement, action is being taken to have the allocation fixed by regulation. The 3.5 mc band is very important to the NZ-ers, as they serve their probationary period up there; and, secondly, the band is more widely used, as the static problem is not so acute as here in Australia.

VK2IC Bert Clarke has a daughter who is quite interested in amateur radio—she even attends the WIA meetings. Just to make sure she doesn't lose touch with the game she is engaged to Stan Bourke, VK2EL. It is a little hard to decide now which transmitter to use, as both VK2IC and VK2EL are in the same shack. Congratulations to the YL and Stan.

and solder here in 6 seconds

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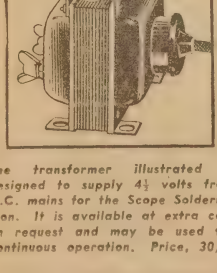

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ARRL DX CONTEST

The ARRL DX contest rules, as usual, were late in arriving. During recent years they never reach here on time.

The first intimation that Australian stations had of the contest was hearing the hordes of W stations active. There was, too, a change in the several numbering system, and the three numbers attached to the RST report should have indicated the power input in watts being used on the band in operation.

Australians were caught out, some using 000 watts, others 999 watts. The last may take some explaining! The first was just as bad—it meant 1KW!

Eighty metres still supplies some interesting DX contacts. The New Zealanders are doing particularly well. The best periods over there are during the early evenings, when they work through to Europe and Africa, and later when W stations are easily received and contacted.

ZL1CI, for instance, had a two-hour contact with a VE5, using only 10 watts input. Here conditions have fallen away to Europe in the mornings, but W stations can be worked around 2200 hrs EAST.

Amateurs in Singapore and Malaya VS1-3, will be looking for Australian contacts each Friday evening at 2300 hrs EAST.

Seven hundred amateurs in Great Britain have notified the RSGB that they have not as yet received food parcels from the WIA. One hundred and fifty names from the 700 applications received have been forwarded to Australia. It is a nice gesture from VK amateurs, and in keeping with the traditions of the hobby. WIA divisions would be pleased to receive donations towards the cost of food parcels.

2AHA reports ZZ9XY was the most called station of the month. Works on 14 mc/s, and Harold would be pleased to learn of his Qth.

UHF BANDS

50 mc activity has fallen off a little since the openings of midsummer are not appearing so regularly.

One DX contact was recorded on Saturday, March 4—VK2ABC contacted KH6PP at 1700 hrs. The KH6 was heard by quite a number of Sydney stations.

Some good extended ground wave contacts have been made and, for the first time, the gap between Sydney and Tumut was bridged, VK2JU Sydney contacting VK2PN. The path of 180 miles is over very bad country. VK2JU's signal to Tumut has been received at good strength on many occasions.

During the Gladesville Radio Club field day on the UHF's, Bruce Glassop VK2BG, operating from the Gib near Mittagong, exchanged S8 signals with Jack Hill, VK2ADT, Cessnock, for a 144 mc record, the distance being 125 miles. VK2BG used a stacked array, and the signal strength in Sydney was tremendous.

OH2OK, in Finland, using 400 watts on the 50 mc band, is looking for Australian contacts. Incidentally, OH2OK's signals on the 144 mc band were heard in England recently. G5QA, in Exeter, heard the OH at 1930 GMT, the distance an all-time record for reception—132 miles.

Ken Finney, VK2AIL, has presented the NSW UHF Section a silver cup to be given to the amateur performing the most valuable and outstanding work on the UHF's during 1950.

Saturday evening, March 11, saw a widespread opening, although not a very satisfactory one, as fading was very bad. KH6PP was heard by VK2VW and VK2JU for quite a period. He was rather weak and was in contact with ZL2AGD. The ZL's came in for a period of three hours and later VK5HD was extremely strong.

The NSW UHF Section will be running on April 16, a field day, using the 144, 288 and 576 mc bands. The arrangements are in the hands of VK2BG and 2YM. If you can make it, please contact either of the former.

YOUR OPPORTUNITY—

to join the world-wide ranks of amateur transmitters! The Wireless Institute of Australia holds regular classes in Sydney to assist Sydney and suburban enthusiasts to obtain their Amateur Operator Certificates of Proficiency.

Write for particulars to the Class Manager, W.I.A., Box 1734, G.P.O., Sydney.

OFF THE RECORD — NEWS & REVIEWS

My recent article on "Pick-up Performance", in which I detailed the reconstruction of a modern lightweight pick-up to improve its response, has apparently created much interest among readers. Many have written to me asking for further information, and to suggest what they could do to their own pick-ups.

By JOHN MOYLE

O answer some of these en masse I might say that lthough my remarks on revamp-ng pick-ups applies in general to ll magnetic types, not all of them ill repay the work you might ut into them. In this regard uite an important point to watch : the availability of spare parts hould you destroy an armature in ne process. This, of course, was ne big feature of the pick-up we sed—replacement plates are ob-ainable for a few shillings.

Referring to the queries concern-ng old type heavyweight pick-ups, would say that, while in some ises improvements can be made, any of these are constructed in uch a way that the rubber damp-ng cannot easily be varied to in-rease the compliance.

Thus, while lightening the arma-ure assembly might be quite prac-cable, reduction in record wear by ncreased compliance and counter-veighting to reduce needle-point ressure might be a difficult matter.

Some of these old pick-ups used arious methods of varying the ressure on rubber blocks which ormed the damping. Quite a useful mount of experiment is, therefore, ossible with them with a corre-ponding improvement, but it is lmost certain that nothing like the ésults will be possible which were btained from the Model 12A.

MASS REDUCTION

The same, I think, is true of the nass reduction. A great deal of the nass of such armatures is contained ound the chuck, which cannot be ightened too much without weaken-ng the set-screw socket. Further-nore, there is little one can do bout the old style needles them-elves. The use of a rod sapphire night help here, although it is not nade to take the firm grip of the et-screw, and might easily snap n half. And unless the needle-point ressure can be reduced to less than wo ounces it might be dangerous o use the sapphire, anyhow.

To readers using these old pick-ips my advice would be to discard hem as soon as possible and re-lace with a modern lightweight. In ome cases this would mean aban-loning the automatic stop, but, in ny view, this isn't much of a depri-ation. A good pick-up is so light n weight that it isn't a good thing o subject it to the side pressure eeded to operate an automatic top, particularly if the movement is at all stiff, and some of the old ones were quite bad in this respect.

So please do not plunge into the job of revamping an old Garrard, Collaro, BTH, Columbia, or similar type of head with the idea of ending up with results even remotely resembling those quoted with my article. My idea was to make a good pick-up into a better one, not to make an old and poor pick-up into a good one.

I came across a letter written to an English journal the other day in which the correspondent deplored the suggestion that lightweights and sapphires should be used with old-style records.

He referred to the "bushy mass of swarf around the tip of a decent sapphire after playing even a modern record under ideal conditions."

ABOUT SAPPHIRES

Let me say right now that I completely disagree with this man that such a state of affairs is normal. If the sapphire is in good order and not overweighted even the heaviest modern recording shows little more

A few notable recordings of Chamber Music

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Budapest String Quartet
With Milton Katims, Viola LX.8592/4

BRAHMS
QUARTET IN A MINOR, OP. 51, No. 2
Busch Quartet LX.8575/8

MOZART
SERENADE IN B FLAT, K.361
(For Thirteen Wood Instruments)
Wind Soloists of the Vienna Philharmonic Orchestra
Conducted by Wilhelm Furtwangler .. DB.9226/30

BEETHOVEN
QUARTET IN C MINOR, OP. 18, No. 4
The Paganini Quartet
Henri Temianka, Gustave Rosseels, Robert Courte and Robert Maas DB.9162/4

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than a trace of grey dust on the point after playing.

Any suggestion of black deposit or "swarf" is an almost certain indication that conditions are far from being ideal, and I should say that the sapphire tip is chipped or badly worn if it shows any appreciable signs of this nature. Immediate replacement is absolutely essential as these things are sure indications of record wear. A good sapphire, properly used, will wear records less than any other tip I know of. In fact, diamond tips are available in England (at an appropriate price) and they are much harder than the sapphire—indestructible over many years.

As far as old records are concerned I see no reason why the wear should be greater than with modern discs, with the proviso that, as the groove diameter is likely to be greater with them, the point diameter should be if possible, 3.5 mils, and certainly not less than 2.5 mils.

The finer points will almost certainly rest on the bottom of the grooves, and therefore tend to carve them out. Provided the point does not cut into the sides due to its poor fit, this does not necessarily ruin the records for playing with a larger tip, but the chances are that "point skating" will not do them any good.

OLD RECORDS

By old records, I mean those going well back and into the acoustic period. Such records may have no great musical value, but because they cannot be replaced, there is no reason why we should expose them to undue wear.

I have no serious objection to thorn needles used with new or old records, apart from their effect on reproduction, although some schools of thought insist that the greater friction and opportunity for rough particles to become embedded in the thorn set up undesirable amounts of record wear. Although I would not like to hazard an opinion about this without careful tests, I am convinced by many years' experience that thorn needles do not mean no record wear at all. I think they are best avoided if there is no real need for them, and the ultra-lightweight pickup and suitable sapphire point has almost sent them into the category of old motor-cars and radio sets.

ABOUT CABINETS

Having had occasion to fit a modern radiogram into an average type cabinet, as available at the present time, I was rather struck with the truth of many points I raised recently in these columns about resonance in the cabinet itself.

I'm afraid that today's cabinets are made more for the convenience of the maker than the user. Strong frames and heavy timber seem to have been abandoned in favor of joining up panels of plywood with a minimum of bracing. This does succeed in keeping the final price to a figure which is merely high and not astronomical, but it does set problems for the constructor.

The effects of resonance in the cabinet and a certain amount in the tone arm, reinforced the bass response in my case, so that any form of bass boost was almost superfluous and was quite dangerous to use to any degree at more than low volume.

The vibration set up in the cabinet tended to create acoustic feedback which in many cases might be a very real problem. If the set is hung vertically from the motor board, the temptation to screw it down to the back of the speaker baffle is just asking for trouble. In this position the chassis is clamped firmly only a few inches from the speaker itself and vibration transferred directly to the valves is likely to greatly accentuate the effect. A better scheme is to support the chassis from the motor board itself, making sure that it is firmly supported to the cabinet.

GOOD RESULTS

The net result, using a standard type of 12-inch speaker, was quite good, but not to be compared with a good speaker in a special enclosure free from the threat of acoustic feedback. I can only underline once again the point that unless the cabinet is an exceptionally good one, the separate speaker mounting is almost essential if good volume and full range are to be expected. The cabinet then becomes little more than a house for the equipment, and possibly some records.

My Own Receiver

(Continued from Page 57)

purely to avoid shunting the AVC voltage.

As it is now, the tuner will separate the locals—but only just! The sensitivity is just enough also, measuring about two or three thousand microvolts, according to frequency. But the sideboards are certainly there in force and, on some nights the 10 Kc. whistle from adjacent carriers makes it essential to use the top-cut filter at 8.5 Kc. Even then my old TRF tuner sounds a very different proposition from the superhet elsewhere in the house.

I have a few ideas about a new wide-land tuner—one with a flat-topped curve rather than the broad oval of a TRF. But there are a few of other more urgent jobs to be done first.

One point is worthy of special mention. When all the units were ultimately connected together, there was a tendency to motor-boating with the bass control advanced. This was traced to interaction between the audio end, through the B-plus line to the tuner circuits—notably the R.F. amplifier screens.

Rather than provide a complete separate power supply, or run the risk of further trouble, the B-plus was taken direct for the rectifier cathode, through a large dropping resistor to a separate 16 mfd. filter condenser.

The voltage available at the filter end is only about 150 but this is ample for such a simple tuner. There was not much incentive to go searching for a high inductive choke for use in place of the resistor. After all the tuner works well and that is the chief requirement.

A GRID-DIP OSCILLATOR

(Continued from Page 81)

be remembered that, unlike the case with lumped resonant circuits, the grid-dip oscillator will respond to harmonics of aerial lengths and, as mentioned above, the harmonics will not be exact multiples of a half-wave.

In checking aerial lengths, it is always advisable to couple the coil of the unit at a maximum current point and, as far as possible, to make the check with the elements near to the operating position, particularly in the case of parasitic beam arrays.

Disconnect the feeders for this check and temporarily close the centre of the element if it is a straight or folded dipole. Once the dipole has been resonated, attach the feeder and check for any variation in dipole resonance. The indication will not now be as sharp as before because of the damping or loading effect of the feeder.

TUNED FEEDERS

With tuned feeders which have been tuned too, or just happen to be at resonance, their attachment to the dipole will not upset its condition of resonance. If the feeders are out of resonance, use the unit at the transmitter end adjusting the lumped L or C or the feeder length.

With untuned lines, two conditions can exist. If their attachment affects the dipole resonance, it is fairly obvious that the impedance matching requires adjustment. If the dipole resonance is not affected, the line can be either "flat" or resonant with consequent standing waves. To check for the latter, simply use the unit as a standing wave indicator.

A point to watch when checking tuned feeders is that it is possible to obtain conditions of resonance both higher and lower than the operating frequency. This is so, because such feeders can resonate as a long wire antenna doubled back on itself.

For the matching of untuned lines, the unit can be used as a signal generator to excite the aerial or array whilst the standing waves are checked with another sensitive indicator, such as the bridge type.

PARASITIC BEAMS

For tuning parasitic beams, adjust resonance of the driven element, with the feeder disconnected, as mentioned above. The parasitic elements should be set to their calculated lengths. The feeder should then be connected and any matching completed. The grid-dip oscillator can now be used to excite the array by link-coupling to the feeder line while a receiver, with an S meter, coupled to a short pick-up aerial some distance away can be used to note the effects of the adjustments to the length of the parasitic elements.

Remember that the coupling of the line to the unit should be rather loose, otherwise the calibration change will be quite marked. However, the monitoring receiver will soon tell whether the calibration of the instrument has been changed greatly by the coupling.

Finally, go through the whole procedure again as any alteration in the length of spacing of the parasitic elements will have disturbed the resonance of the driven element. It is wise to check for any change in these conditions of the array as it is positioned in various directions, particularly those in which it may swing close to buildings or other objects. If there is noticeable variation, adjust the array for optimum performance or make the final adjustments whilst it is pointing in the direction most used.

LINE SECTIONS

It will be realised that the unit is very handy when cutting lines, either open wire or coaxial, to some resonant length. For shorted quarter-waves, couple the unit to the shorted end. If fittings are to be used with the line, these should be attached when resonance measurement is taken. For quarter-wave open lines, temporarily short one end and check as above. The length of the short-circuit will introduce a slight error depending upon the length of the short, which, for open wire lines mainly, will depend upon the line spacing.

For shorted half-wave open lines, couple to the centre between the open and shorted ends. With coaxial cable, resonate at half the desired frequency. The resonant frequency of the cable for this condition will be twice the reading obtained on the oscillator frequency scale.

For open-circuited half-wave lines, couple at the centre as before. For open-circuited coaxial cables of this length, short one end and check at this short for resonance at half the desired frequency. Provided that this short-circuit at one end is made as direct as possible the frequency of the cable thus checked will, when the short is removed, be twice that reading shown on the oscillator frequency scale.

For all measurements on line sections, keep in the back of your mind the relationship between electrical and physical length. It is possible to end up, unthinkingly, with a half-wavelength of line instead of an intended quarter-wavelength.

L AND C

There are many other instances where the instrument can be used to throw light on the question of resonance. It has not been possible to cover them all. We leave it to the individual to build up his own repertoire of uses bearing in mind his own requirements. We have not attempted to mention how it is possible to measure values of inductance and capacitance over a reasonable range with this instrument. However, this facility is not as important as the other uses mentioned and, furthermore, it can be done with possible greater accuracy by other means. Nevertheless, we may make it the subject of a short article at a later date.

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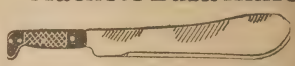

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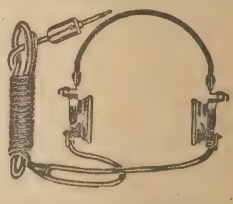

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THE HISTORY OF ELECTRICITY, 10

(Continued from Page 13).

Academy of Sciences on October 2, 1820, its projector must, in fairness, be numbered among the few claimants for the honor of being designated "Father of the Electric Telegraph."

This was about as far as Andre Marie Ampere went in the science of electricity. He laid the foundations, cleared away a mass of former misconceptions, and indicated where others might build. But he took little, if any, part in the subsequent work of applying electrical science to practical ends.

Indeed, Ampere's life at this period seems to have become one entirely of routine. His salary was small and he had accustomed himself to living in what used to be termed "gentile poverty." In many respects, Ampere, during the height of his fame, seems to have been the typical personification of the legendary absent-minded professor. If we are to believe various accounts of his ways and habits he would often when lecturing to his students on a hot summer's day, mop his forehead with the blackboard duster and immediately afterwards proceed to wipe out the blackboard figures with his silk handkerchief.

AMPERE'S ESSAI

Almost his last creative work was Ampere's *Essai sur la Philosophie des Sciences*, a work which he did not live to complete but which was afterwards published in its incomplete form in 1838. Ampere's last *Essai* attempts to present the whole range of science and natural knowledge to the student. It begins by dividing science into two large categories, material science and the science of mind or thought. Each of these two divisions was subdivided, and by this means more than a hundred branches of natural science were obtained.

Some of Ampere's names for his arbitrary science divisions sound fantastic to our ears. Who has ever heard of the sciences of "terpnognosy," "technesthetics," "coenolbology," and "cybernetics," to mention but a few of the strange names in Ampere's last *Essai*?

The *Essai* is, indeed, a work of a lifetime's intensive learning, and a tremendous tribute to the ingenuity of its author, but, all the same, it is unbalanced, impracticable, unfinished, and, as such, has been forgotten for three generations.

FAILING HEALTH

As he grew older Ampere's health became feebler, and the time eventually came when he had to leave Paris and to go south in search of relief from his chronic chest trouble. He went to Marseilles hoping that the gentle breezes of the Mediterranean would restore him at least partially. But he had no sooner got there than he was seized with a brain-fever. It was his last illness, from which he died on June 10, 1836.

The scientific world regretted Ampere's passing. Although retiring, nervous, shy, and impracticable, Ampere had made a great impression, through his original work, upon contemporary scientists and philosophers. They acknowledged his originality, if somewhat belatedly, and they raised monuments to him.

But the greatest monument of all came in 1881 when the International Congress of Electricians met in Paris and agreed to designate the term "ampere" the unit of electrical quantity, thereby translating into living language the memory of a man who had done so much to establish the foundations of electrical science.

RADIATION—THE NEW DANGER

(Continued from Page 15).

The liver is one organ which does not suffer as much damage by radiation as do others. For this reason the livers of animals have been selected as good subjects for experiment. Small highly radioactive beads are planted in this organ and the effects watched.

We have often read about tagged fish, that is, fish which have been marked and then let go so that its migrations through the seas of the world can be followed. To hear about a tagged atom however seems a tall story. It is true enough, nevertheless.

A radio isotope is a tagged atom. It is a by-product of the manufacture of Plutonium, and of the atom smasher, the cyclotron.

With the cyclotron, they seem to be able to make anything radioactive. Thus, iodine can be made radioactive, and if this iodine is administered to a patient it will immediately make for that part of the body which has an affinity for iodine, the thyroid gland, for instance. Here it can be watched to see what happens.

If the iodine is intensely radioactive it can cause damage. Hence, if a dose of this is deliberately given for the purposes of causing damage to an animal, the progress of the damage can be seen. All these experiments are gradually leading to a method of control and treatment of damage by radiation. They will assist in the eventual use of atomic energy by removing the terrors associated with its production.

In a few years' time we may be able to take our choice of various methods of protection. Take your pick. Will you have your kidneys encased in lead? Will you be put into the quick freezer? Will you swallow a dose of cysteine one hour before an atom-bomb drops? Will you be painted with toluidine blue, or will you go live in a nice deep coalmine for the duration?

A Course in Television

(Continued from Page 51)

paper read by him before the Fre liver twice the output on modulat up to 1 Mc. (two sidebands) as modulation in excess of 1 Mc. (sideband).

To restore the balance, it is nec sary to locate the nominal video on the slope of the I.F. respo curve and at a point where the sponse is down by 50 per cent 6 db. Furthermore, the curve sho ideally roll off, in this case, just o 1 Mc. from the nominal I.F. and c tinue smoothly to at least 1 M the other side.

An overall response of this nat tends to balance the output from t video detector for all modulation f quencies, irrespective of whether t energy comes from one sideband o or from both.

At the other end of the curve, t video I.F. response must fall aw sharply and thereby reject the cor ponents belonging to the F.M. sou channel.

This assumes, of course, that t I.F. systems are quite separate a that there are no composite I.F. stag handling both frequencies. Receive have been designed using one more composite stages, but it is obv ously necessary to separate the sou and video signals at some poi either by appropriate "trap" circui or by making the A.M. video dete tor unresponsive to F.M. sound con ponents and vice versa. More will b said of this in later articles.

As might be imagined, it is no eas task to meet these special selectivit requirements and the story become very largely one of interstage cou ling methods. Due attention has to b paid to achieving the utmost stabilit in the I.F. transformers, since mech anical variations in service coul easily upset the most careful factor adjustments. It is an advantage, course, to use coupling metho which do not require a highly in volved alignment procedure.

Even assuming that the designe is able to produce a satisfactory an a stable video I.F. channel, the ques tion obviously arises as to how th receiver is to be tuned in service. non-technical viewer can hardly b expected to watch picture detai closely enough each time to place th video I.F. at a precise spot on a re sponse curve.

The answer to this difficulty is pro vided, in a multi-station system, b preserving a given frequency rela tionship at all times between th sound and vision carriers. Even with F.M. the sound carrier tuning is muc sharper than the video tuning, an can be used as a basis of adjustment either by aural means or by a suit able indicator. If the receiver is cor rectly adjusted, tuning the sound channel accurately will place the video signals and the video I.F. a the right spot on the response curve.

So much then for the basic design requirements. Next month we will examine in more detail how these requirements are met, together with their influence on valve types and interstage coupling.

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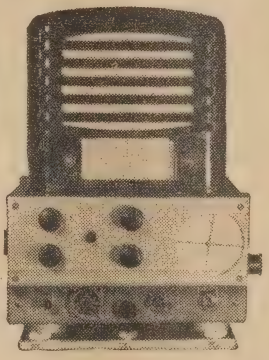

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ANSWERS TO CORRESPONDENTS

R.P.G. (Glasshouse Mts., via Brisbane, Qld.) notifies us of a change of address and makes further comments upon his intended activities in radio.

A.: Thanks for your letters, R.P.G. Your change of address has been duly noted by the subscription department. We agree that the provision of a-c power mains in your location will widen your scope for experiment. You are, no doubt, already aware of the description of the Recording Amplifier which appeared in the September, 1947, issue of R. and H. We hope to publish further articles on recording in the future.

J.D. (Hobart, Tas.) makes comment upon the Australian Hobby Handbook recently released and offers suggestions for inclusion in future issues.

A.: We are very pleased to note your enthusiasm for the Hobby Handbook, J.D., and we trust that all future issues meet with the same approval. Your suggestions have been noted and will be borne in mind when the next issue is being prepared.

L.C. (Inglewood, WA) asks if we can tell him where he can purchase a kit of tools suitable for working perspex and similar materials.

A.: Unfortunately we have no information on this subject, L.C., but suggest that you write directly to P. Rowe and Co., of 297 Castlereagh Street, Sydney. Alternatively, some reader may be able to help you and in case they can we are publishing your name and address, so that they may write to you directly. L. Carpenter, 182 Roseberry Street, Inglewood, WA.

M.E.McD. (Proserpine, North Qld.) sends in some suggestions on choke coupled drivers for class B amplifiers. He also suggests that the new KT61 valve would be a good class AB2 amplifier because of its small bias requirements.

A.: The methods of drive you mention is not new and has been used commercially for a number of years. We have not used it, however, because amplifiers of this type are not high fidelity types and there is not a big demand for high-powered amplifiers of this type. As for the KT61 valves. There are no class AB2 ratings for these valves and we think that the high grid current which is likely to flow when the grids are made positive would damage these valves.

B.D. (Elsternwick, Vic.) sends in a change of address and also remarks on our practice of coding circuit diagrams.

A.: The change of address has been passed on to the subscription department, B.D., and your next issue will be sent to this address. Thank you very much for the nice remarks and also for the criticism of our drawing methods. We are always interested to hear readers' opinions on our articles and drawings, &c. Acually the method of coding circuit diagrams was introduced to allow us to correspondingly code underchassis photographs to help beginners. We will admit, however, that it can be a nuisance when the value of a component is wanted in a hurry.

L.B. (Wollongong, NSW) has recently purchased a BC659A and asks for information "showing how it is connected."

A.: Well, L.B., we have no data on this particular unit. Hazarding a guess, we feel that our memory suggests an IFF transmitter/receiver. If this is so, the unit will be of little use as it stands other than for wrecking for component parts. If any readers have more definite information, L.B.'s address is 18 Loftus Street.

J.R.W. (Broadford, ?——?) intends to install a home lighting plant and is thinking of standardising on 24 volts, as he has seen a large amount of 24-volt equipment advertised lately.

A.: The economy or otherwise of your scheme depends on use you have in mind for the plant. It must be kept in mind that most of the 24-volt equipment which has been advertised recently is ex-disposals and the supply will not continue indefinitely. Further, as far as we know, standard household accessories, such as jugs, toasters, &c., are not available for 24-volt operation. Therefore, despite the immediate attraction of cheap disposals motors at the moment, it may be well worth considering a standard 32-volt plant. We regret that, as yet, we have not had an opportunity to conduct experiments with home lighting plants and are, therefore, not in a position to make any first-hand information on the subject available to readers. We are not familiar with the generators you mention and can only suggest you write to the advertiser concerned. Thanks for the kind remarks.

YOUR QUERY?

1. Queries will be answered in rotation through the columns of our magazine if not accompanied by a fee for a postal reply.
2. Queries, neatly and concisely set out, will be answered by mail as quickly as possible if accompanied by 1/- in postal notes or postage stamps. Endorse envelope "Query."
3. Back numbers are rarely available but reprints of most circuits, wiring diagrams, and parts lists will be supplied for 6d each, minimum charge 1/-. Thus a circuit, layout, and parts list will cost 1/6 in stamps or a postal note. Endorse envelope "Circuit."
4. Blueprints of exact size chassis layouts with all essential holes and cut-outs will be supplied, if available, for 2/6. Endorse envelope "Blueprint."

Address your letters to the Technical Editor, Radio & Hobbies, Box 2728C, GPO, Sydney.

SPECIAL NOTE:—

In an admirable thirst for knowledge, some of our readers have been submitting letters which read more like a technical quiz session than legitimate queries! We do want to help you, but there is a definite limit of time which can be set aside for answers. Some conscience-stricken readers have enclosed up to 5/- with their letters, but much as we appreciate the thought, the fact is that if we spend all our time answering involved questions, we will have no time left for the magazine.

Help us, therefore, by restricting your queries to troubles you are having in your contructional work, by asking not more than two or three at a time, and by avoiding general theoretical questions which it is not the function of the Query Service to answer.

—THE EDITOR

J.V.T. (of Bardon, Qld.) wishes to obtain the circuit of a personal portable suitable for use in the country and also in a car. He has the circuit of a well-known 4-valve commercial portable, but was wondering if we could supply him with something better.

A.: We happen to be familiar with the little set you mention and have respect for its performance. However, it is almost certain that you could not duplicate the performance since it is mainly due to specialised component design rather than the circuit. For better performance in a home-built receiver, it would be necessary to employ an RF stage, a larger speaker and the full 90-volts high tension. This rather puts set out of the "pocket" class. "Senior Portable" is a set along th lines and a circuit for it is avail through the shilling query service. shielding inside most sedan cars is fa good and satisfactory pickup on the l aerial is almost impossible. It is poss to connect a portable to an exte aerial on the car but the arrangem is still unsatisfactory because batte operated portables do not have a su cient reserve of volume to overcome general noise level, even with the quie of cars on good roads. For good rec tion while in motion, a specialised radio, such as the "Karset," which described in the May, 1949, issue, is only worthwhile solution.

J.B. (of Cooranbong, NSW) read article in a magazine which stated t a type of crystal detector gave bet results with a battery connected in ser in such a way that current flows throu the crystal.

A.: Yes, J.B., this is correct. Howev this particular type of crystal is not sensitive as several of the more comm types of crystals even when the batte is applied. Fixed crystals, such as t IN34 germanium diode, are now ava able and, in addition to having the a vantage of requiring no adjustment, th are more sensitive than most catswhisk types.

R.G.H. (Naracoorte, SA) writes expres ing his pleasure with Radio and Hobbi and says he has had excellent servi from the B class battery amplifier recent described. It is built with high-quali transformers, &c., and gives plenty power output as well as good ton quality. He suggests that there shou be quite a few country readers interest in building a battery-operated tuner use with such amplifiers.

A.: We read your letter with conside able interest and will duly pass on yo compliments to the "Serviceman Wh Tells." Your suggestion is certainly novel one, but well worth while cor sidering, and we will keep it in min Glad to know that the B class amplifi is working so well.

J.H.S. (Auckland, NZ) writes in congratulate us on the "Australian Hobb Handbook." He says that he hopes is to be one of a series, with the nex edition available soon.

Thank you very much for the kin remarks J.H.S., and we are very please to know that the book is appreciated NZ. At the moment we can not sa exactly when the next edition will b available, our present idea being to brin the handbook out annually.

E.S. (Sofala, Vic.) sends in some sug gestions for several articles.

Thank you very much for the sug gestions, E.S., we have passed them o to the contributors concerned. We d not intend to describe an enlarged ver sion of the "Bandspread Six" but sugges that you could use the audio end of the "Senior Radiogram" in place of the one described with the receiver. Thank you also for your kind remarks about R & H

A.L. Agricultural High School (Lawes Q'ld.) sends in some hints for the "A Reader Built It" Page of R & H and also some questions for "Here's Your Answer Tom."

Thanks very much for the hints A.L., we have filed them for possible future use in the "A Reader Built It" columns. The "Here's Your Answer Tom" questions will be answered as soon as possible.

A.W.B.A. (Wilston, Brisbane) says that he has been unable to obtain a 10,000 ohms speaker transformer for a Rola 3C speaker and he wonders if he may be able to get one in Sydney.

Normally this transformer is carried by all suppliers of radio parts and we can only suggest that you write directly to one of our advertisers. If you can obtain one it would be quite permissible to use a 7000 or 8000 ohm transformer. The difference in practice, is quite small and certainly not sufficient to detract from the performance of the little set in question.

J.F.C. (Berwick, Vic.) tells us of some his experiences in servicing radio sets. hanks very much for the letter J.F.C. have passed it on to the Service- n who will, no doubt, use it in his icles in due course.

.N. (St. Kilda, Vic.) sends in a cir- t for comment.

hanks very much for the circuit N. We will deal with it as soon as ssible through the pages of the maga- e.

. R. Pidgeon (47 Arcadia St., Pens- rst, NSW) tells us of the success he s had with a "Vibro Five" receiver ich he has mounted on his motor bike. is receiver, he states, has proved to excellent both mechanically and elec- cally. It is built in four sections so that can be easily installed on a motor ce. Mr. Pidgeon says that he is quite lling to supply information on this in- llation to any reader and for this ason we have included his full name d address.

Thank you very much for your kind marks and we were very pleased to ar of your success with the vibrator t. You may care to outline your set r possible description in the "Reader ilt It" page.

H.V.F. (Geraldine, NZ) takes us to sk over a comment in the February sue of R & H. We said that we had ever heard of a 6A8-GT and H.V.F. lls us that he has an American 6A8 hich is of the "GT" type.

Thanks for correcting us H.V.F., we ould have said that there is no Aus- alian made 6A8-GT and American valves this type are very scarce in this ountry. Thank you for the kind remarks

C.A. McI. (Toorak, Vic.) sends in the circuit of a single tracer for comment in the "Junior Experimenter" section of Radio and Hobbies.

Thanks for the good wishes, we will comment on your circuit as soon as possible.

J.G.R. (Tusmore, Sth. Australia) sends in some questions and a circuit for review in the "Junior Experimenter" section of R & H.

Thanks for the circuit, J.G.R., we will deal with it at the first available opportunity.

L.S.K. (of Charlestown, NSW) writes in to tell us that he has now been a subscriber to Wireless Weekly and Radio and Hobbies for a quarter of a century. He also says many nice things about the magazine and says he very much appreciates the "Serviceman Who Tells" articles. He also believes in helping younger, less experienced experimenters with their problems so that they will not lose interest in the art of radio.

A.: Thank you very much for the letter and the remarks, L.S.K. We were very pleased to hear how long you have been a subscriber and think it must just about be a record. Thank you for the comments about the "Serviceman" articles. They certainly seem to interest a great number of readers. We were also pleased to hear of your interest in young experimenters. Yours is certainly a fine attitude to take to them.

S.H.S. (of Lane Cove, NSW) tells us of the satisfaction which he has had with the performance of the Karset of the May, 1949, issue of R. and H.

A.: Very pleased to note your enthusiasm for the set, S.H.S., also that you had little difficulty in installing the set in your car. Your suggestion of taking the drive for the AVC voltage from the plate of the 6AV6 instead of the 6BA6 is a little wide of the mark because there is no RF component at the plate of the 6AV6, it being an audio valve in the circuit. The plate of the 6BA6 IF amplifier is the only logical place from where this drive to the AVC diode plate can be obtained. The Modulated Oscillator to which you refer in your letter was described in the December, 1943, issue of R. and H. The circuit diagram, parts list and coil data are available through the Query Service for the usual charge of 1/6.

R.B. (of Coolamon, NSW) sends in some questions for the "Answer Tom" page and submitted a circuit for possible correction. He also tells of some of his experiences as a bush serviceman.

A.: Well, R.B., you certainly have your share of work, but we were pleased to hear that you still manage to follow your radio hobby. You will be pleased to know that your circuit and layout appear to be quite OK and we may possibly use them in "A Reader Built It" page at some future date. The questions you submitted will be answered as soon as possible in the appropriate section of the magazine.

B.G.S. (of Annandale, NSW) asks if we could describe a beat frequency oscillator which would cover the range of 0-150 Kc. and similar to the types used by the PMG Department. He also wants details of the band pass filter as used with this oscillator.

A.: Well, B.G.S., that is a very tall order and beyond the scope of our magazine. Such instruments are extremely complicated and cost many hundreds of pounds. The frequency stability and wave form required, need to be excellent, and such an instrument is a far cry from the simple oscillators we have described in the past. Even if we did have the time it would be impossible to design the filters you mention, as you did not give any details of the impedances into which they have to work.

J.K. (of Sydney, NSW) is a beginner with radio as a hobby and asks us to recommend a book to assist him.

A.: A simply explained, well-illustrated and inexpensive little book for beginners is An Elementary Wireless Course for Beginners, by J. H. Reyner. The diagrams are prepared in the usual European style, but are very easy to follow even if you happen to be accustomed only to seeing American and Australian style diagrams. The ARRL Handbook is an excellent text for those interested in radio as a hobby, particularly with a view to becoming a transmitting amateur. The book begins with simple electron theory and continues to discuss the design of powerful transmitters. The style of the book is very concise and may prove a little "heavy" until you have read the simpler book. There are beginners' articles appearing in Radio and Hobbies each month and these also will be of help to you.

R.P.H., (Shepparton, Vic.) sends us a report of the excellent results he has had with a small regenerative receiver built from a circuit published in the September, 1943, issue of R & H. He says that the stations logged are too numerous to mention them all but he also says that he has received New Zealand and other overseas broadcast stations at excellent strength. He also asks where he can buy a WXI Westector in Melbourne.

A. We were very pleased to hear of the success you have had with your small set and the results are certainly gratifying. The Westector should be available from many of the larger Melbourne radio houses, but if you still have trouble in obtaining it we suggest that you write directly to Amplion Pty. Ltd., of 36 Parramatta Road, Camperdown, NSW, who will be only too happy to supply you.

V.J.G. (Beresfield, NSW) asks if we can supply details of a 5 or 6 valve portable which will operate from both batteries and the A.C. supply mains.

A. A circuit along these lines is the "Universal Portable," the required retails of which can be supplied through the shilling query service. Our original design did not provide for the A.C. power unit to be mounted in the same cabinet as the receiver, however. You could possibly modify this point to suit yourself.

R.W. (Mackay, Qld.) sends in a novel circuit for comment in the "Junior Experimenter' section.

A. Many thanks for your interest and we will file your circuit for consideration.

D.A.M. (Lindfield, NSW) is another reader to forward a circuit for comment in the "Junior Experimenter" section.

A. Your circuit has been filed for consideration. Many thanks for your interest.

E.J.N. (Nhill, Vic.) encloses items for both the "Junior Experimenter" and "Reader Built It" pages.

A. Thanks for your interest. We cannot promise to use all your entries but we will do our best.

E.P.B. (Bexley, NSW) wishes to obtain the circuit of a wire recorder which he believes we published some time ago. He is also interested in disc recordings.

A. Sorry, E.P.B., owing to the earlier difficulty in obtaining suitable wire in this country, and more recently the lack of time, we have not considered the design of a wire recorder from the point of view of our readers. We suggest that you watch the advertisements in Radio and Hobbies with regard to recording units.

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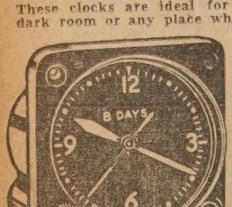

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M. GOODMAN

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E.L. (Preston, Vic.) wishes to obtain some information on an amplifier and tuner system for installation in a factory. He particularly asks our advice about power requirements and speaker placement.

A. We have the circuits of a number of amplifiers and tuners in our files and can supply them through the shilling query service. However, the installation of a public address system such as you have in mind, requires a certain amount of local knowledge both to judge the power and number and type of speakers required. Therefore, it is difficult for us to be of very much assistance to you in this matter. Obtain the services of a PA expert who could inspect the premises.

E.K.B. (Neutral Bay, NSW) notifies of change of address and makes a few suggestions on material for inclusion in the magazine.

A. The subscription department has made the necessary alterations regarding your address, E.K.B. Your suggestions are appreciated, although you will find that most issues carry information on scientific advances made both here and overseas, the sources of information not necessarily being those mentioned in your letter.

W.F.F. (Bourke Line, NSW) speaks of voltage rise in 32 volt home lighting outfits. He also mentions his activities in operating vibrator sets from such plants.

A. The contents of your letter were quite interesting, W.F.F., especially regarding the voltage rise of lead-acid accumulators under charge. Due comments have already been made in these columns.

F.S. (Boronia, Vic.) is interested in electric trains and asks us about the motor, speed control and reversing equipment.

A. Sorry, F.S., but this matter is beyond the scope of Radio and Hobbies at the moment and we have no information which would be of assistance to you.

L.W.R. (of Dalwallinu, WA) writes at length on the subject of 32 volt lighting plants and is apprehensive about the effect of rising voltage on valve heaters.

A. As you will have observed by this, many other readers have written in on the same subject and all agree that one has to be prepared for voltages of 40 or more under charging conditions. While a voltage rise of this order is clearly undesirable, we do not share your immediate apprehension about the valve heaters. In an ordinary auto installation, the receiver operates most of the time with the generator charging and a voltage which often gets up to around 8. This would be equivalent to 40 volts from 32 volt system and it is likely that the proportion of operating time under high voltage conditions would be much lower than in an auto set. It can only be accepted as a tribute to the valves that they withstand it, apparently without obvious ill effect. Nevertheless, the idea of using a three-way switch to cut in a series resistor between line and radio when the generator is charging has much to recommend it and, if the resistor is suitably bypassed to form an R.F. filter at the same time, so much the better. The valve ratings extend to 6.3 plus 10%, which is near enough to 35 volts for the full network. The resistor could be proportioned along with the line resistance, to drop the resistor operating voltage to 35 under conditions of maximum terminal voltage. It would seem that about 5 ohms would be a good figure in most cases. You need have no fears about your subscription as the appropriate department will advise you automatically when renewal becomes due.

H.R.C. (of Cobden, NZ) is extremely keen on the results obtained recently from a voice coil top cut filter, when feeding into a Goodmans Axiom 12 speaker. Not only does it enable the frequency response to be matched to individual new recordings, but he says that it has "rejuvenated" many of his older discs by eliminating the noise-filled upper register.

A. We were very pleased to receive your report and there was no need to be apologetic about the length of your letter in this case. We are very keen on the whole business of sound reproduction and are interested to read the experiences of readers who have followed up various features in the magazine. It would be very unsatisfactory if we never knew whether our articles met the needs of readers or not.

J.H. (Oakdale, NSW) is another reader to make mention of the voltage rise in 32 volt home-lighting plants when under charge.

A. We thank you J.H., for your interest in making the points in your letter. Your figures are quite correct. We are glad to know that you find the contents of the magazine quite interesting.

D.T. (of Hobart, Tas.) is very keen on model planes and has a limited knowledge of radio. He wants to know whether we have any intention of running information on the subject and suggest that it could be covered in a couple of well-written articles.

A. We are naturally au fait with the general position of radio control and there is certainly a quickening interest in the subject. However, there is a lot more to it than most enthusiasts apparently realise and we will simply not have the time or the space in the immediate future to give the matter our attention. While the circuitry does not appear very difficult, at first glance, anyone with a knowledge of radio transmitters, relays, &c., will realise that a good deal is generally involved in their adjustment. The experimenter must also have an accurate means of measuring and maintaining the frequency of the controlling transmitter, since any variation from the specified figure would quickly attract the attention of the licensing authorities. Another point is that all flights would have to be on a planned basis, as there would be every chance of models responding to signals from different transmitters, perhaps miles apart. In other words, D.T., we think it would take a lot more than the suggested two articles to put intending instructors in the clear.

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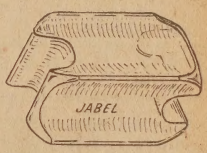

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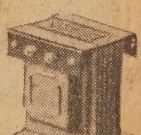

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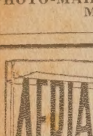

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FOR SALE: Radiogram cabinet as new, £10 or best offer. **J. Stack, 24 The Boulevarde, Cammeray, N.S.W.**

FOR SALE: Two table radios "Fireside Five." Reasonable condition. £12 each. No cabinet. **F. W. Roberts, Togar Sig. Box via Scone Railway Station.**

FOR SALE: R & H's, from July '40 to Dec., '46. 73 issues, good condition. Offer. **E. Lockie, 14 Alexandra St., South Yarra, Vic.**

Readers wishing to buy, sell or exchange goods are invited to insert an advertisement on this page. The cost is 1/6 per line; approximately 5 words to a line. Advertisements for the next issue must reach our office by NOON, WEDNESDAY, April 12, 1950. Dealers' Advertisements not accepted.

FOR SALE: B.C. 348 Receiver. Converted for 240v. Excellent condition. £33. **Ring XU4519, Sydney.**

FOR SALE: Modulated Oscillator, AC. Covers 100 kc/s to 28 Mc/s. New. Bargain, £18. **186 Buckley St., Footscray, Vic.**

FOR SALE: U.S. Sig. Corps BC348 Receiver, New Class C Wavemeter, Astatic T3 X-tal Mic. Offers to 92 P.O., Bundaberg.

SALE: Complete set of R. & H. Every issue. What offers. **Carr, Box 93, Parkes.**

SALE: C.R.O. Ferguson 3 inch Scope, practically brand new, £30 or offer. **VK2T1, FF1705.**

SALE: Q.S.T. Complete 1933 to 1949 £25. Single Volumes £2. Single copies 10/-. **VK2T1, FF1705.**

SALE: Ensign Commando Camera, f3.5 lens, coupled range finder, case and all accessories. Absolute bargain at £38. Guaranteed perfect. **Adams, 81 Beaumont St., Hamilton, N.S.W.**

SALE: Connoisseur Pick-up and trans. Hardly used. Two sapphire needles, £3. **D. Miller, 99 Links Ave., Nth. Strathfield. UF2012.**

SALE: "Mighty Mites" 1.11 speakers to match. Pocket Taylor meter. AC/DC. Brand new. Best offer. **B. Hepburn, Lady Davidson Home, Turramurra.**

SALE: Photo enlarger. Home-made, contains two faultless 6-inch condensers, 12in. F/L and 3.5 lens from Coronet camera. Operates well. £7. Also two Brinex 6inch condensers, £3. **W. Thompson 65 Morgan Street, Kingsgrove, NSW.**

SELL: AWA 3B Transmitter, D104 X-tal Microphone, 30 watt AB1 P.P. 6L6 Modulator. Complete with power supply input X-tal Mic. **F. R. O'Sullivan, 173 Walker St., Bundaberg.**

SELL: 109 and Kingsley receivers, crystal calibrator, wave-meter, transmitter components, tubes, milliameters, relays. **Hinckley, Oleander Drive, Ashgrove, Brisbane. Phone FW1031.**

SELL: Philips 2" oscilloscope, £20 as new. Philips impedance bridge as new £5. Calstan tube checker counter type £5. **R. Horsburgh, P.O. Box 265 Warracknabeal, Vic.**

SELL: AR14 R.A.A.F. Receiver. Perfect cond. 16 coils 110kc—16mc continuous. New batteries, instruction manual, carrying case, £6 or offer. **K. Watkinson, 296 Bell St., W. Coburg, Melb.**

SELL: Complete parts R. & H. Eleven valve short waver communications receiver, £15. Also handi-talkie less batteries, £5. 60 watt phone and C.W. De-Luxe transmitter, £50. **D. Gilder, 17 Onslow Ave., Elizabeth Bay, N.S.W.**

SELL: Complete New Capitol Traverse Gear & Young Atom. P.U., £5/15/-. New "Airzone" motor, 7000 r.p.m., 1-5 h.p., 230V, 7 gns. **H. Smith, 165 Glen Eira Road, S.2, Victoria.**

SELL: Bargain, 2-valve set, 19-104, with phones, battery, excellent performer £5. 1K5G-4, brand new no batteries, no speaker, £6. **Denham, Jnr., High Street, Bateman's Bay.**

WANTED: Copies Scientific American **Fuller, 406 Pennant Hills Rd., Pennant Hills.**

WANTED TO BUY: A.R.7 Receiver, type 3MK. II, R.C.16.B., A.T.R.4, 109 F.S.6 or type A. MK. III Transceivers. **G. Laver, Fish Creek, Vic.**

WANTED: "Flight," 15th Sept., '49 **Harding, 42 Spring St., Lismore, NSW.**

WANT: VA 13 A.S.S. Amp. 12v with or less valves or exchange 32v ¼ h.p. motor. Cadet portable rcvr. What have you. **F. Brown, Barcaldine, Q'ld.**

WANTED: "Flight," 15th September 1949. Write **K. A. Harding, 42 Spring St., Lismore, NSW.**

WANTED: American Popular Mechanics Magazines. **B. Holmquist Rawlinson St., Newtown, Bega, NSW.**

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